# Romance of Pen Industries,

BEING

## A Complete Manual for the Manufacture

OF

## Writing Materials,

their History, Progress, and Effects on human advancement, with special reference to the Economics and Prosperity Problems of India.

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BY

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*With many illustrations.*

"THE MORE SCIENCE ADVANCES, THE MORE IT BECOMES CONCENTRATED IN LITTLE BOOKS."—*Liebnitz.*

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Sir John Prescott Hewett, K.C.S.I., C.I.E.,
Lieutenant-Governor of the United Provinces of Agra and Oudh.

THIS WORK

IS MOST RESPECTFULLY DEDICATED

BY KIND PERMISSION

TO

THE HON'BLE SIR JOHN PRESCOTT HEWETT,

K.C.S.I., C.I.E.,

LIEUTENANT-GOVERNOR OF THE UNITED PROVINCES

OF AGRA AND OUDH,

THE FIRST MEMBER FOR COMMERCE AND INDUSTRY

ON THE VICEROY'S COUNCIL,

FOR HIS GREAT SYMPATHY AND ZEAL FOR THE

ADVANCE OF INDIAN INDUSTRY

AND AGRICULTURE.

BY HIS MOST HUMBLE SERVANT,

THE AUTHOR.

# Preface.

India .is now passing a transitional period in her industrial life. Mr. Glyn Barlow in his "Industrial India" justly characterized the patience of an Indian labourer with that of the proverbially "patient animal." Contentment is well and good in the labourer within a reasonable limit, but not so in the employer as it hinders the industrial efficiency. He should know that "time is money." Industrial life is like a soldier's life where the industrial hero or the consummate man of business will win the "battle of business." He should, therefore, accept all time-saving machinery instead of sticking to old-time manual tools and methods which can never give him real efficiency.

The object of the author in compiling this little book, is to show to those who are interested in the industrial salvation of India what a vast undeveloped field for scientific research and well-equipped organized work, India is at present, and to point out what a low position she is occupying in both her internal and external commerce in spite of her natural resources, which very few countries on the face of the globe possess to an equal extent. Self-sufficient ease and "the bliss of ignorance" have eaten into the core of national character, and even with apparently "cheap labour" the Indian labour is dearer, being less efficient than the "dear labour" of other countries.

If only the catalytic influence of the most practical nation on the earth—the British—can transform the many-sided, but potential, energy of the Indians into a more kinetic one, it would be a great gain to both the countries.

Should this work help, even to the smallest extent—

(1) to divert the Indian thought towards the industrial and agricultural development of the country by means of up-to-date methods and scientific manure, (2) to impress upon the absolute necessity of self-help and co-operation—more than any extraneous help or "protection"—for the development of modern Indian Industrial life and labour, (3) to diffuse sounder and more reasonable views of the changeable and unchangeable laws of economics without indulging in futile dogmas, (4) to give a well-informed survey of the economic possibilities of India and of her present position in the industrial world by offering some ideas of the most progressive nations' workshops of the world, (5) to arouse an interest in invention and discovery, in Science and Research work, and (6) to advance the growing taste and desire for technical knowledge,—the author will deem his labour amply compensated. India can have no claim to the world's admiration unless the Indians themselves can contribute again their proper share in the world's progress.

The author is indebted to his friends, Babu Mahendra Nath Nundy, B.A., of the United Free Church School, Chinsurah, for his kindly reading over and rewriting the whole of the manuscript and correcting the proof-sheets; to Babu Batuk Deb Mookerjee, M.A., zamindar, Chinsurah, and Honorary Secretary, Bharat Dharma Mahamandal, Benares, for his most valuable suggestions and aid in the preparation of the work; and also to Babu Panchanan Banerjee, zamindar, Brikutsha in Rajshahi, and also of Benares, for his taking pains to execute several photographs for this book.

*Benares, December,* 1910.

# Contents.

# Romance of Pen Industries.

## A Retrospect of Invention, Industry and Science.

WORK AND PROGRESS—these two alone lead to the evolution of human happiness in a country which enjoys the blessings of peace, leading to the preservation and advancement of mankind, and to the security of the two prime rights of the individual and the family, forming the terrestrial *Trinity* in the father, mother and child and including the rights of property and the pursuit of happiness. Inventive faculty is as old as humanity, and invention or constructive work is man's attribute. Unlike instinct, creative germ or progressiveness lies hidden in most men, and is individually cultured or developed by education according to the innate principle and its environments.

Industry, commerce, agriculture and intellectual labour are the four pillars of civilization. Wealth is in work. Money makes money, and man must exert himself to beget money. Industry is the salvation of a race. "Go to the frugal ant and learn of her ways and be wise," was the advice tendered by Solomon, the sage of old to men who looked down upon industry as a menial pursuit. This principle of frugality or improvement ingrained in the animal nature of man, is the vivifying principle of the individual and

of the society. Intellect and industry are never incompatible with the physical and moral nature of man—life has time enough for both. It is by the labour of mind or body that the tree of life bears fruit. It is commerce that confers a "general industry of mind and hardiness of body" accompanied with honour and plenty on mankind. The prime cause of the origin of industry, whether in man or in animal—carnivorous or herbivorous—is the search for food or sustenance. The rudiment or origin of human industry is foreshadowed in the animal industries, arts and crafts. We find the animals not only hunting and fishing, making wars and expeditions to procure food, but also harvesting and reaping, storing in barns, domesticating various species, defending themselves against the attacks of enemies and protecting themselves from cold, heat and rain by means of dwellings. The engineering beaver, the Indian weaver-bird, the Indian tailor bird, the carpenter-bee, the saw-fly, the tumble-bug, the honey and wax-making bee, the builder termite, the silk-spinning caterpillar, the web-spinning spider, the trap-door spider, the lac-insect, the coral-insect, the paper-making ant, the sexton beetle, and the prospecting woodpecker are a few of the master craftsmen of the animal world.

Since mankind is distributed all over the big world, and labour, like the vibrations of Æther, is exchanged and distributed for labour everywhere in the service of mankind, therefore, external trade or commerce (which is another name for international traffic in exchange for goods), distributing territorial labour for the gratification of real and reciprocal wants—like knowledge that elevates humanity, or like light that

dispels darkness—cannot continue the policy of selfish exclusion or morbid isolation or monopoly in the commercial stage of the world in this present era of international culture and co-operation for universal human progress in physical, mental and moral well-being. Commerce in the end pays for all, in spite of selfish monopolies. It is the key-stone of the industrial enterprise of all countries by which the various races of humanity are becoming mutual debtors and creditors and are bound by common interests through mutual reliance and reciprocal service. A country that shuts out commerce cannot have any voice in the affairs of mankind, and voluntarily cripples itself like a Chinese woman bandaging her feet, for with the stoppage of its life blood the heart of the nation fails, and it sinks into second childhood, *sans* teeth, *sans* eyes and *sans* everything. A beggar and an indolent nation, without creative energy, without the power of initiative and sustained striving, like the idle wheel of a machine or like a handless watch, is always at the mercy of a civilized active commercial nation. Like the belly and its members, the moral, the religious, and all other progress of a country must ever depend on its material prosperity, and as they are of one family, happy is the country where they dwell together in union. The cash or I.O.U. of a nation, like the falling rains or flowing water and manure, forces production and exchange of goods for goods, despite "the craft of the lawyer and of leech" or the so-called helpful international Tariff laws, which are merely instruments for raising of the revenue of a Government.

The indestructibility of matter, the evolution of the species, the conservation of energy, the uniform-

ity of matter, the responsivity of the animal mind throughout the animal kingdom and the new science of anthropology, unmistakably point that all the five branches of mankind, by whatever they do or know in the visible economy of Nature or by their tribal or national culture, are intimately associated by a common latent link of thought, sentiment, aspiration, interest and the instinct of self-preservation. Geology, Archæology and Zoology, from the darkest dawn of time, assert that the isolated types of nature sooner or later become extinct The isolated civilizations of the East and the West thus became extinct by physiological and moral causes or by the final dissipation of their energy, and as paralysis of the tongue shows that the belly is soon to follow, so the decay of classical languages, like extinct volcanoes, indicates the downfall of ancient nations.

England and America of to-day prove, that the world's strongest blood is the world's most mixed blood, which nourished by a mixed diet, moves in all the phases of human activities—whether mental, moral or physical—and that the most blended and cosmopolitan English tongue as an universal commercial and literary language or like the Esperanto, has become the most efficient medium of expression of thought of half the mankind.

Japan, the true modern disciple of the West, is another example of her unique and rapid progress in arts, industries laws, languages, philosophies and sciences, since the shaking off of her spirit of isolation in 1853 by introducing a complete system of compulsory Western education. From a nation of Agriculture and Art, to-day the Japanese industrial competition makes itself felt in the world's market.

The Russo-Japanese War in 1903-5 shows the real progress made by Japan as the greatest naval power in the Far East.

The industrial supremacy of Germany of to-day is due entirely to her system of scientific education of her people.

India, once the sun of the Old World, the home of Humanity and the cradle of all knowledge and civilization, that invented myriads of industries, arts, languages, institutions, laws, philosophies or faiths and the first advances of science, does not create any now. Her progress ended in stagnation and retrogression. When men and nations originate they live and grow The people that ceases to invent ceases to grow. An individual, a nation, a religion, a society or an industry that refuses from indifference, prejudice or tradition to recognize fresh facts, signs its own death-warrant and constantly lives a threatened existence.

In this intellectual age the mind—the *primum mobile* of civilization— has breathed into matter. In this progressive epoch of industrial civilization the mind is the king and the machinery is its prime minister. Efficiency is its watch-word and the Limited Liability Company is the goal of man's partnership with Nature. Mind and metal have both risen in significance. Of the industrial Trinity brain or knowledge is no less an important factor than capital or labour is in business. Man's naked hand and unaided understanding can accomplish very little mental or manual work without instrumental help. As the mechanical means of machineries strengthen the feeble hands of his *unaided body*, so are the arts of Writing and Printing, the greatest mechanical

levers of his *unaided mind.* An inventor like an athlete is made and not born. Adaptation unlike heredity or instinct involves conscious effort. The fruits of education and culture cannot be inherited. Withheld from civilization a man—the creature of habits—might even revert to the primitive state like a parasitic insect or a plant. Given the blessings of education and learning, he may rise to civilization. The Maoris of New Zealand that have passed from barbarism to civilization within a single generation furnish an example.

Experimental observation is the greatest asset of the inventor or the open-eyed philosopher of fact. The way to invent is to keep thinking. Success or fruition is the consummation of persistent effort at generalisation and inference. Invention is as much a process of physical growth as life is. The oak is born of the acorn. As union is strength, so like trade unions, the associations of inventors as world's thinkers and workers have to-day formed into the modern formidable Patent Factory Systems. To-day human art imitates what Nature as the ultimate authority has done in the functions of a plant or an animal and in every field of form, size, property and measurement of the mineral, the vegetable and the animal kingdom. The observant man alone possessing "eyes" falls in "love at first sight," and can read the great picture-book of Nature full of sciences. He has ears to hear Her patent "voice" of information and Her language of facts. He finds "tongues" or truth in every tree and "sermons" or wisdom in every brook. Genius, as the great Edison says, is ninety-eight per cent. perspiration and two per cent. inspiration. Necessity or human want is the mother

of invention and progress, for man naturally responds, spontaneously from within outwards, to the needs of his environments by the conscious responsivity and aspiration of his mind. True genius or the power of making efforts consists in taking the right kind of pain without which even the most splendid natural gifts, wanting the gift of continuance, are often wasted like the talents or the wealth of an intellectual or monetary miser.

Invention was not esteemed in the Middle Ages ; on the contrary, there were violent opposition, hostility, persecution and cruelty to scientific research, discovery and mechanical invention. There was a constant bug-bear of machinery as displacer of handwork ignoring its power of extension and dominion over industry. Socrates was condemned to die by swallowing the juice of Hemlock. Galileo did not escape the torture of the Inquisition, and Bruno was burnt at the stake for his fearless vindication of the doctrine of Copernicus. Bernard Palissy, the potter, was thrown into prison at his extreme old age for his religious utterances. Even the great Galen was forbidden the use of the scalpel of science on the dead bodies at Rome, while the Romans enjoyed with frenzied delight the living tortures of thousands of gladiators at their amphitheatres. To-day intellect is free and science has no fear of the prison or the stake for its radical utterances.

During the pre-historic ages of Speaking and Writing and for fifteen hundred years of the Christian era, mankind could not shake off the bondage of literature and dogma and the thraldom of authority as the foundation of all knowledge. Ignorant or non-thinking people dreaded the individually acquired light of

knowledge, as destructive fire is instinctively avoided by the lower animals.

The mediæval seat of learning and scientific research and the birth-place of modern Western Science was at Alexandria in Egypt where a great museum and a famous library were founded by Ptolemy. Aristotle, the founder of the natural sciences—Euclid, Archimedes and Hero flourished during the Alexandrian age 384—130 B.C. There was not a single creative devotee of science for 800 years during the Roman epoch, and the classical and Alexandrian influences were passed on to the Mahomedan conquerors who about 753 to 832 A.D. were engaged in scientific researches. We see that from the Indian peninsula the first advances of the sciences of Mathematics, *Astronomy and Chemistry spread into the valleys of* the Nile and the Euphrates in Egypt and Arabia, all through Persia to Phoenicia, and thence propagated by the Saracens into Europe—once the appendage of Asia—the ancient queen of the continents.

It was the Saracens who introduced science into the Italian peninsula and established the first astronomical observatory at Seville in Spain in the Iberian peninsula. The mariner's compass known to prehistoric China was re-invented by Gioja, the Italian, in the fourteenth century, which made navigation in the pathless waste of waters a success in the fifteenth century. It was the greatest invention of the fourteenth century.

The fifteenth century gave to the world the wonderful and mysterious Art of Printing or Ready-writing, and the five pioneers of modern thought, namely,—Leonardo in the Engineering Science, Christopher Columbus and Vasco-da-Gama in com-

mercial enterprise, Copernicus in the pure Science of Astronomy and Martin Luther, the greatest thought-stirrer and social Reformer. From Speech to Writing, from Writing to Printing there has been a slow and gradual evolution through the vistas of the unknown past. The art of writing is no longer the monopoly of the Aristocracy and the Clergy or Priesthood, whether in India or in Europe, to be wielded zealously as a weapon of authority or supremacy of man over his fellowman or as the dreaded engine of enslavement; but combined with the art of printing, it has become the peaceful engine of liberation of the human mind. The divine art of Printing, by diffusing knowledge, has changed the old method of teaching, preaching and governing in the fields of literature, theology and politics. Thanks to printing alone to-day, both the thraldom of Nature and the tyrannies of sword, superstition and money are rapidly passing away by the abolition of the slave trade, by the growth of freedom of speech, thought and belief within the bounds of law, and by the growth of individualism or collectivism in trade or society—leaving man the master of his fate and nature.

The sixteenth century produced Ferdinand Magellan, Paracelsus, Francis Bacon, Benedetti, Tycho Brahe and Galileo, with the discovery and invention of the Telescope and the Thermometer.

The seventeenth century gave to the world its Kepler and Newton, Descartes, Liebnitz, Huygens, William Harvey, Torricelli and Von Guericke. From this time theoretical mathematics assumed a practical shape, and Euclid's line of length without breadth became the line of a moving point.

The modern Research Laboratories with their private or public endowments are creations of modern times all over the world. The Royal Society of London (1662), and the Academy of Science, Paris (1666), were established in the seventeenth century. The Royal Academy of Sciences at Berlin was founded in 1700. The Imperial Academy of Sciences at St. Petersburg was established in 1725, and the Royal Swedish Academy followed in 1781.

In the eighteenth century Dr. Black, the discoverer of the composition of water, Dr. Priestly, the discoverer of Oxygen, Cavendish, the discoverer of Nitrogen, the Swedish Chemist Scheele, the discoverer of Chlorine, and the French savant Lavoisier, the reformer in chemical nomenclature, laid the foundation stones of the modern Science of Chemistry dealing with the nature of matter and energy. They subverted the old ideas of Empirical Chemistry, the theory of Phlogiston of Stahl, the belief in the time-honoured elementary nature of the earth, the air, the fire and the water. For the incalculable benefits they conferred on humanity they did not escape persecution and cruelty. Dr. Priestly was driven out of England to America by a fanatical mob who burned his house and demolished his church, and Lavoisier, who proved the indestructibility of matter, was put to the guillotine. Such is the pathetic story of the first discoverers of Science.

In Biology, morbid Anatomy and in Physiology Haller, Morgagni, William Hunter, John Hunter, the Italian Spallanzani and Erasmus Darwin discovered the mysteries of the muscular irritability or nervous Physiology, the secrets of Embryology and development, the functions of the Lymphatic system, the pro-

cess of the collateral circulation of blood, the secrets of the chemistry of digestion, the chemistry of respiration—animal or vegetable,—the controversion of the so-called theory of abiogenesis or spontaneous generation—and thus laid the foundation of the modern Biological Science dealing with the problems of life and mind. The foundation of modern Geology was laid by Dr. James Hutton of Edinburgh (1781).

The end of the eighteenth century witnessed the evolution of the Steam Engine by James Watt in 1790, and the giant steam thus became the motive power in the power-looms of Dr. Cartwright, in the Railway Locomotive of George Stephenson, in the steam-boat of Symington and Fulton, in the printing press of Koenig—the four giant industries of the nineteenth century.

For eight hundred years from the eighth to the fifteenth century men eagerly sought the "philosopher's stone" and the "Elixir of life," and for three subsequent centuries from the sixteenth to the eighteenth mankind followed the craze of the "*perpetuum mobile*."

The nineteenth century witnessed the evolution of the sciences from out of the misty realms of metaphysics—unparalleled in the history of mankind. Amongst the world's greatest workers and scientific benefactors of this unique age are—George Stephenson and Morse; Huxley, Haeckel and Darwin; Lyell and Tyndall; Jenner and Pasteur; Virchow and Koch; Franklin and Davy; Dalton and Berzelius, Farraday and Bell; Bessemer and Nobel; Abbe and Welsbach; Mayer, Helmholtz and Joule; Edison and Marcony; Wallace and Kelvin; Lister and Crookes;

Rayleigh and Ramsay; Lockyer and Dewar; Roentgen and Madame Currie.

The electric Telegraph, the Telephone, the Dynamo and the electric Motor; the petroleum, the gas and the electric illumination, the safety match, the steam locomotive and the steam-boat; the bicycle and the motor-car; the photograph and the sewing-machine; the phonograph and the spectroscope; the gas-engine, the wireless Telegraph and the Roentgen rays; the vulcanized Rubber; the Lino-type machine and the Type-writer; the discovery of quinine, auscultation, stethoscope and opthalmoscope in medicine; the discovery of chloroform and anæsthesia in surgery; the manufacture of aluminium and calcium carbide and the discovery in 1898 of the world-renowned Radium by Madame Currie are the epoch-making inventions and discoveries of the nineteenth century. To-day the rule of thumb is dead and the rule of science has taken its place. The blundering hindsight of the rule of thumb is replaced by the foresight of science.

The conquests of Science, Invention and Discovery recorded by the pen and the press reveal to us that the so-called good old time or "golden age" is not behind us but before us, and that the human race in this modern "era of gracious living" has visibly progressed by culture or labour alone from the darkest geological dawn of life at least forty million years ago, passing from the *pithecanthropus erectus* or the erect ape-man stage through the long and disagreeable period of development or frog-like metamorphosis of the brute-man of the pre-glacial and the glacial or the drift age, the stone age, the bronze age and the coal or iron age—emancipating mankind from the tyrannies of

ignorance and superstition and conferring the blessings of health, wealth, peace and prosperity on earth.

The cosmopolitan effects of commerce and industry, which are the ultimate embodiment of man's physical and moral nature evolved out of his intellectual inventions and his restless activities, have vastly augmented international wealth and mutual prosperity by means of increased efficiency and distribution of labour, have diffused the blessings of civilizations, the power of knowledge and of science to the darkest corners of the habitable globe, and have to-day formed no less potent bond of Union and Peace between the universal societies of nations by their mutual interests and reciprocal obligations than what has been accomplished in the past or in the present by the combined agencies of philosophy, theology and the destructive art of war.

## The Origin of the Alphabet (2500 B.C.).

The word Alphabet is derived from "*Alpha*" and "*Beta*"—the first two letters of the Greek Alphabet. The two greatest legacies of ancient science which have been handed down to us by our distinguished ancestors were the art of speech and the art of writing, both of which can well be termed the pioneers of our Wireless Message and the most wonderful of all human inventions. Art and literature have sprung into existence from the toiling intelligence and enterprise of man, for trade is as old as human speech. The industrial languages of the different coloured races of mankind did not crop up ready-made. During the Drift age, or the Stone age, the primitive

man, whether living in mountain caves or the fruitful shores and valleys of the great rivers, satisfied his three prime necessities of food, shelter and raiment by hunting and fishing, cave-dwelling and skin-clothing, and gradually learnt fire-making, tool-making, the domestication of animals, the culture of the soil, the art of spinning and weaving and metal-working—the last four being the four pre-historic Industries. The fore-runners of the modern mills were shadowed forth by the flour-grinding mills (*Panchakky*), the bullock-power oil mills (*Ghanny*) and the husking mills (*Dhenky*) of the ancient Indians. As society advanced the pristine man finally invented the art of speech. Like the coral reef formation the valleys of the Indus and the Ganges in India, the valleys of the Euphrates and the Nile in the far Asian West—from Persia to Phœnicia, and the valleys of the Yellow River and the Yang-tse-Kiang in China in the far Asian East—formed three distinct nucleoli around which the three ancient civilizations of Asia—the Cradle of Humanity—sprang up. Before speech gave birth to alphabet man became a sign-maker on fragments of bone, horn, stone or slate and other materials during the palaeolithic Reindeer Period. The quipus or knotted chords of the Peruvian Registrar, the looped or knotted chord reckoning among the Mexican Zuni, the Wampums or shell-ornamented belts, and the Australian message stick were the mnemonic or memory-aiding ancestors of the alphabet. In India even to-day counting with the fingers, pebbles, beans and cowrie shells reckoning and written signs by dot and perpendicular strokes drawn by means of charcoal, chalk and vermillion are freely used by the illiterate laity devoid of the elementary

education or knowledge of the three R's—Reading, Writing and Arithmetic. The Arabic numerals derived from India were introduced by the Saracen traders of Egypt and Syria into Spain in the Middle Ages, whence they found their way into England through Europe about the eleventh century The Sanskrit and the Bengali numerals are derived directly from the appendages of the letters of the Sanskrit and the Bengali alphabets, respectively.

The pictograph, however, is the parent of the modern European alphabet. The origin of the Western alphabet is seen to have been developed through four stages, namely, mnemonic or memory aiding, the pictorial or Hieroglyphic, the ideographic or symbolic, and lastly the phonetic or sound sign for each letter of the vowels and consonants. The modern European alphabet is derived by imitation from the industrial alphabet of the commercial Phœnicians The Phœnicians acquired the art of writing by imitating the Babylonian or the Egyptian alphabet. The Grecian alphabet was derived from Phœnicia and ascribed to Kadmus who first carried the letters to Greece according to a familiar Greek legend. The Romans in turn had acquired their alphabet from the Grecians.

It is a matter of fact that from a very ancient time all the alien nations on the West of India from Persia to Phœnicia—namely, the Persians, the Saracens, the Assyrians and the Babylonians, the Egyptians, the Phœnicians, the Hebrews, the Grecians and the Romans—and the Chinese in the East of India all had commercial intercourse with her The lines in writing that are found in all parts of the world fall under three divisions—namely (*a*) from left to right

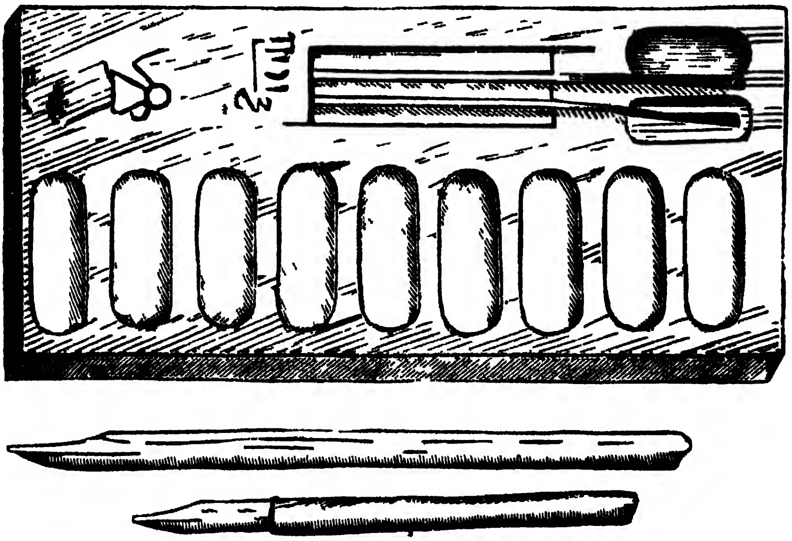
as in Europe, (*b*) from right to left as in Arabia and Persia, and (*c*) from above below as in China and Japan. It can, therefore, be easily seen that India from its central peninsular position of the Old World —the mother of all the existing 250 alphabets and the land of 164 different scripts and languages that are still extant—combined all the three methods of writing in line as is found in the Sanskrit and the Bengali alphabets.* The origin and the excellence of the Indian alphabet, specially as it contains a complete system of phonetic symbols of vowels and consonants, founded on exact linear geometrical science of the Vedic Age at least 2500 B.C , prove that it did not borrow from the Persian or the Chinese, or from the Phœnician, the Grecian or the Roman alphabet.

## The Writing Materials of the Ancients.

The carving of signs on monuments was the first attempt of recording the human thought. The Indian iron style and reed-pen for writing on palm leaves and "Bhurja" sheets, stone and copper-plate inscriptions, the brush of the Egyptian Scribe and the Papyrus sheet scrolls containing heiroglyphics written with carbon ink, the metal, bone or ivory style and square clay tablets or clay books with cuneiform inscriptions of the Assyrians and the Babylonians generally known as the Chaldeans, the Scandinavian flint knife of the recorder of Runes and Oghams on wood and granite, the reed-pen of the Hebrew prophet for writing on the Papyrus with carbon ink, the brush-pen of the Chinese and the

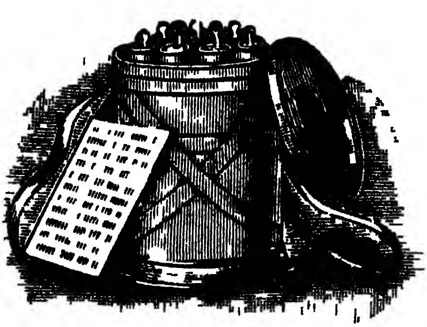
* **For detailed particulars of the Origin of the Bengali Alphabet please see author's *Sarala Barna Jnan*, Parts I and II.**

Japanese, the bronze and ivory style, parchment and vellum skins obtained from Pergamos, and wax

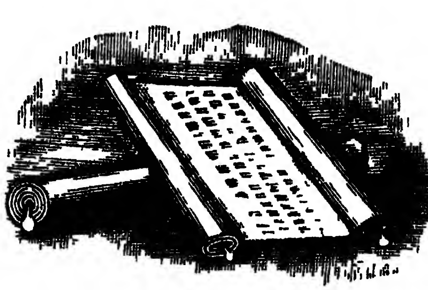


*Egyptian palette, brushes, and pens.*

tablets on wood of the Greeks and the Romans were the writing materials of the ancients. With the



**Scrinum with Rolls.**



**Papyrus Manuscript.**

*Roman Scrinum, or case, with Rolls of Papyrus.*

advent of modern writing, the writing materials and the forms of symbols have all been simplified.

*The Pen.*—Of the four recording instruments of the modern time,—*viz.*, the pen, the printing press, the Photographic Camera and the Phonograph that have all immortalized human thought,—the pen stands pre-eminent as the greatest peaceful agent of civilization and the potent agent of liberation of the human mind. The evolution of the pen, the ink and the paper has all been slow through a period of at least ten thousand years of man's history of civilization in this earth. It is by the Pen and the Press that the race of Adam has tasted of the fruits of the "for-

*Ancient Roman Style.*

bidden tree of knowledge" and has wrested the lost paradise from the hands of Satanic or relentless Nature.

1 The English word "Pen," French "plume," German "feder." is derived from the Latin "Penna" meaning a quill from a bird—goose, swan, raven or peacock.

2. The word "Quill" is derived from the old English "quvlle" meaning a reed.

3. The word "Reed" is derived from Latin "calamus."

4. The word "Stylus" is the ancient writing instrument and is retained in the modern word

"style" meaning the way in which a writer expresses his ideas.

5. The word "Ink" is derived from the Latin "tingere" to colour, meaning a liquid that will produce a colour.

6. The word "Tablet" is diminutive of "table," which is derived from the Latin "tabula," a board. The tablets of the bark of the beech tree were the material on which written characters were inscribed.

7. The word "Book" is derived from the Anglo-Saxon "boc" meaning a "beech" tree on the tablets of whose bark written characters were inscribed.

8. The word "Volume" is derived from the Latin "Volumen" meaning a roll, which was the usual form of books in ancient times.

9. The word "Code" is derived from the Latin "Codex" meaning a tree-trunk.

10. The word "Diploma" literally means a paper folded double, from Greek "diploo" to fold.

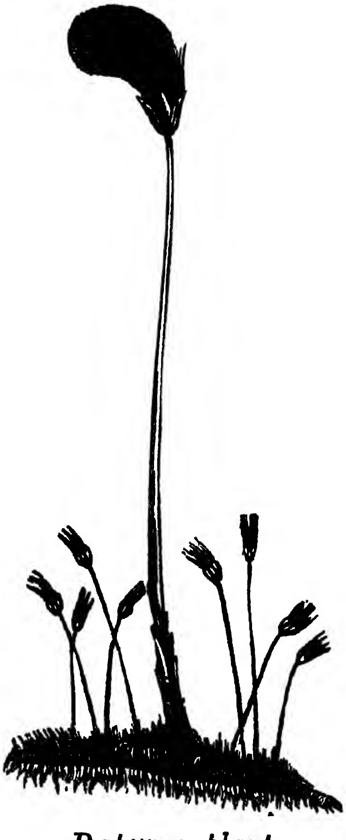
11. The word "Letter" is derived from the French "lettre" meaning to "daub" or "besmear", which was the early mode of writing on tablets smeared with wax.

12. The word "Literature" is derived from the Latin "litera" meaning a letter.

13. The word "Library" is derived from the Latin "liber" meaning the inner bark or rind of a tree used for paper

14. The word "Paper" is derived from "Papyrus", a plant the bark of wh ch was used by the Egyptians for writing. The thin bark of the soft cellular flower-stem of the Papyrus—a reed-like

plant—growing on the banks of the Nile in Egypt, was cut into thin slices and cemented together, pressed, dried and polished so as to form a sheet. The invention of the Papyrus sheets from the thin



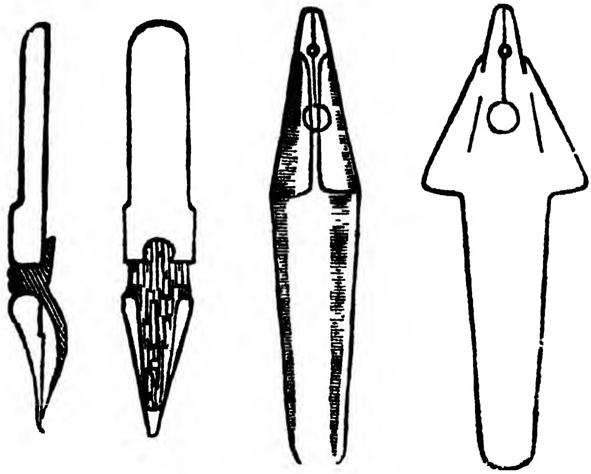
*Papyrus plant.*

layers of the bark of the Papyrus plant was made in Egypt five to eight thousand years before the Christian era. On these sheets the Egyptians painted hieroglyphics or picture-writing by means of palette brushes and pens with carbon inks. For nearly

ght thousand years the Papyrus sheets survived. he Papyrus reed plant is now extinct in Egypt.

The ink-horn and penner carried in the girdle of ie scribes of the Middle Ages, the brass reed tube id the ink bulb, the Japanese pen tube and ink-box bronze and ivory were the *portable forms* of riting materials that were used in ancient times.

The *reservoir ink-stands* of various shapes and esigns and various kinds of *reservoir nibs* came into



*Reservoir nibs.*

se before the invention of the modern Fountain and tylographic pens.

## The Writing Materials of India.

The bark of the "Bhurja" or birch tree and the ng and smooth palm-leaves, the "tulat" or hand-iade cot on paper, the reed-pen or "calamus" and ie peacock quills are still used in India. The

popular legend relates that when an infant is born, the handwriting of Brahma, the *Bidhata Purusha*, is inscribed on the infant's forehead on the sixth night of its birth, which can afterwards be seen in the serrated sutures of a human skull. The creator Brahma gave the knowledge of letters to men, and Devanagree in which the sacred Sanskrit books are written is said to belong to the city of the gods. It was Brahma from whose four mouths emanated the holy texts of the four Vedas The sound which signifies Brahma thus indicates the phonetic origin of the Sanskrit alphabet. The Indian alphabet did not pass through the stages of the pictograph or the syllabic system of writing. By a master touch the Hindus perfected their alphabet of more than forty distinct letters by adding separate letters to represent all sorts of vowel sounds of the human voice—namely, simple vowels, double vowels, dipthongs, tripthongs and compound vowels, and like the ingenious invention of nought, cipher, zero or "sunya" of their Decimal system of Notation, the consonants of the Indian alphabet are further divided into (1) full-sounded consonants without requiring the addition of the separate vowel "a", and into (2) half-sounded consonants by the half-sound indicating simple stroke of the index sign. The Indian alphabet also contains separate half and full sound nasal consonants and the quick impulsive consonants. Ganesa, the god of erudition and wisdom, was the scribe of the immortal sage Vyasa at whose dictation the elephant-headed god wrote the great Epic, the Mahabharata, with reed pen, earthen ink-pot containing carbon ink soaked in cloth instead of sponge, upon palm-leaves used as paper, and with sand-bag or

Guru Mohasaya and Schoolboys

Writing on Palm Leaf with Iron Style, as is still done in India.

powdered lime as substitute for the modern blotting paper. The bulk of the Indian writing is still done by the older methods, namely :—

1. The iron-style for writing on palm-leaves which is still much used in Orissa.

2. The porcupine quill which is used only for making calculations on the dust board.

3. The bamboo reed pen of Bengal.

4. The palm mid-rib pen.

5. The hollow reed-pens imported from Persia and also cultivated in India.

6. The fern petiole pens "Kalmi Kalam" imported from Penang and Singapore.

7. The peacock quill pen as also white goose quills used in Bengal and Assam. In the Tiretta Bazar of Calcutta are also sold the "palette brushes" made of fine camel's hair, packed in a bamboo handle and used by the Chinese as the first type of ink pen.

## Ink—its History.

Writing inks were known before the Christian era at least between 2697—-597 B.C., and is said to have been invented by one Chinese Tien-Tchen. Pliny, Vitruvius, Dioscorides, Martial and other classical authors mention them about the first century of the Christian era. The ink used by the ancient scribes, whether in India, China or Egypt, was of carbon. Various forms of (1) *carbon ink* made from lamp-black with a suitable vehicle gum, oil or water, Chinese ink; Japanese ink, and Sepia ink manufactured by Nature and derived from the ink gland of the cuttle fish were all used up to the tenth century A.D. (2) Iron and *gall ink* was used first in the eleventh century

A.D. in Europe. (3) *Logwood* was afterwards discovered. (4) *Chrome ink* was discovered by Rounge in 1847. (5) *Vanadium ink* was discovered by *Berzelius* in 1835, and (6) *Aniline inks* (nigrosine) afterwards known as the stylographic ink were first used in 1861.

The manufacture of ink on a scientific basis was first made by *William Lewis* in 1748, followed by *Berzelius* and *Bottcher*.

Alizarine ink containing dye-stuffs such as logwood or indigo was introduced about the year 1856. A radical change in the method of ink manufacture was introduced by the well-known firm of Stephens. The new process consisted in keeping the ink from oxidation (unoxidised gall ink) by preventing the oxidising action of atmosphere from closed vessels.*

## The Manufacture of Writing Ink.

*Permanent Blue-black Ink for Stylo-pens.*

Re (Take of)

| | |
|---|---|
| Indigo carmine, pure .. | 1 drachm. |
| Gum Arabic, powdered .. | 150 grains. |
| Tannic Acid, pure and dry .. | 325 ,, |
| Pyrogallic Acid .. .. | 10 ,, |
| Ferrous Sulphate, pure .. | 220 ,, |
| Liquid Carbolic Acid .. | 1 drachm. |
| Simple Syrup .. .. | 90 minims. |
| Distilled water .. .. | 20 ounces. |

Mix.

* For detailed particulars consult Lehner's "Ink Manufacture," Mitchell and Hepworth's "Inks-Composition and Manufacture."

## Aniline Writing Inks.

Aniline ink is simply made by dissolving aniline colours in boiling water and then it is filtered. The addition of gum is not necessary. These inks do not clog or thicken on the pen.

1. *Black aniline ink.*—(Stylographic ink) is made with soluble nigrosine, when dissolved in the proportion of one part in 80 parts of water or one part in 200 parts of water. This solution keeps well, flows readily, and dries to a good black ink but lacks the permanency of iron gall ink.

2. *Blue-black aniline ink* is made with soluble aniline gray in 200 parts of water.

| | | | |
|---|---|---|---|
| Re Methyl violet | .. | .. | 4 grains. |
| Bengal green | .. | .. | 5 ,, |
| Bismarck brown | .. | .. | 3 ,, |
| Gum Arabic | .. | .. | 20 ,, |
| Water | .. | .. | 4 ounces. |

Mix. This is a very cheap stylo-ink and is best suited for ordinary school or correspondence purpose.

3. Permanent blue-black writing ink :—

| | | | |
|---|---|---|---|
| Re Bruised galls | .. | .. | 3 ounces. |
| Iron Sulphate | .. | .. | 1 ounce. |
| Gum Arabic | .. | .. | 1 ,, |
| Vinegar | .. | .. | 1 ,, |

Cold water—enough to make 24 ounces. Pure Indigo Carmine—enough to give a blue tint.

Macerate with frequent shaking for 14 days and then decant.

4. An official ink :—

| | | | |
|---|---|---|---|
| Re Ferrous Sulphate | 30·0 | parts by | weight. |
| Pure dry Tannic Acid | 23·4 | ,, | ,, |
| Crystal Gallic Acid .. | 7·7 | ,, | ,, |
| Powdered Gum Arabic | 10·0 | ,, | ,, |
| Hydrochloric Acid dilute | 25·0 | ,, | ,, |
| Carbolic Acid .. | 1·0 | ,, | ,, |

Aqua—sufficient to make up the mixture at the temperature of 60°F. to the volume of 1000 parts by weight of water.

Red ink :—(Coal-Tar dye inks).

Red magenta makes very beautiful red inks. The green crystals form a dark-red solution in spirit.

1. Red magenta ink :—

| | |
|---|---|
| Re Magenta .. .. .. | 2 |
| Gum .. .. .. | 5 |
| Spirit .. .. .. | 10 |
| Water .. .. .. | 100 |

The magenta is dissolved in spirit 90% strong with the aid of gentle heat. This is then dissolved in cold water, and the solution filtered and then heated to boiling, when the magenta solution is poured slowly into it by constant stirring.

2. Scarlet ink :—

| | |
|---|---|
| Re Eosine (crystalline powder) .. | 2 |
| Gum .. .. .. | 5 |
| Spirit 90% .. .. .. | 10 |
| Water .. .. .. | 100 |

Follow exactly the above process.

Ink manufacture in India :—Large quantities of ink are manufactured in Calcutta and its neighbourhood.

Calcutta ink manufacturers:—The most noted are (1) Messrs. P. M. Bagchi & Co., 16, Canning Street, Calcutta, and (2) Messrs. D. Waldie & Co., Konnagar.

## Paper—History of its Manufacture.

The different materials used as paper by the ancients were the Papyrus sheets of the Egyptians, the inner bark sheets of the "Bhurja" or Birch tree used by the Indians, the skins of animals forming parchment and vellum used in Pergamos in Asia Minor, the square clay tablets or books of the Assyrians, the wooden tablets covered with wax used by the Greeks and Romans, the palm leaves or the plantain leaves and the copper plates of India.

At first paper was made by hand from linen rags, cotton or straw. With the invention of the printing press in the Middle Ages book-making by the slow and laborious process of handwriting vanished for ever. Paper was first invented in India and China from a very ancient time. The Chinese made cotton into pulp and spread it out into thin sheets. The ancient Hindus also made paper from cotton, known as "Tulat," *i.e.*, cotton-made, which is still used by the native merchants. From the Chinese and the Hindus the Saracens learnt the art of making paper from cotton and introduced it into Europe about the eighth century. All paper was hand-made until about 1800. The smooth machine-made glazed paper of the modern time is made from wood-pulp and bleached by chlorine and lime. Like the Indian "Bhurja" sheet, the Papyrus sheet—the ancestor of paper—was used in Europe up to the fifth century. The hand-made paper from rags, cotton or straw was manufactured

in Europe about the eighth century. In the 14th century hand-made paper was largely manufactured in Germany, France, Spain and Italy. The manufacture of hand-made paper was introduced into England at Dartford about 1588 in the reign of Queen Elizabeth, and white paper was made in 1690. In Holland the rag paper was made in 1750. In Germany the straw paper was made in 1756. The making of paper from wood-pulp was first suggested by the French Chemist *Reaumer* in 1790. The discovery of chlorine used for the purpose of bleaching paper was previously made in 1774. The first machine-made paper originated in France in 1790 with the paper-making machine of *Louis Robert* whose endless web-paper was patented in France in 1800. In 1803 *Bryan Donkin* introduced the machine-made paper into England. In 1804 *Henry Fourdrinier*—an English paper-maker and inventor of an improved paper-making machine—further developed its manufacture in England. In 1853 *Mr. Watt* invented the manufacture of paper from wood-pulp. About this time there were about 413 paper mills in England with an output worth two crores of rupees annually. To-day there are over 650 mills in England producing 30 thousand tons of paper a week. England imports 350,000 tons of mechanical wood-pulp and 200,000 tons of pure chemical wood-pulp from America to turn them into paper. In the United States of America the hand-made grey or brown paper was first made by *William Rittenhouse* in Philadelphia in 1794. The machine-made paper was manufactured about 1820, and the introduction of wood-pulp paper made about 1870.

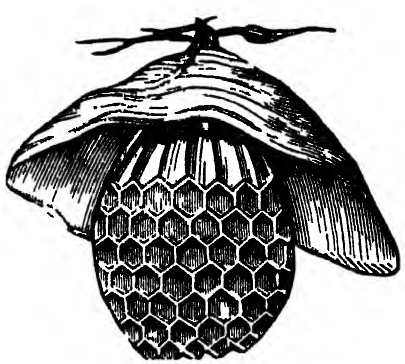
We see therefore that without paper cheaply made by machine there would be no cheap printing, and

without printing there would be no development of the modern industries. The interesting story of the soda industry and its waste product of hydrochloric acid in Great Britain and the removal of the paper duty in 1861 show the striking conversion of waste into wealth by giving an immense stimulus to the paper industry which utilizes mostly the hydrochloric acid for bleaching paper.

## The Indian Paper Mills—their History.

The hand-made paper industry which was entirely carried on by the Mahomedans of Bengal is fast dying out. Formerly hand-made paper was extensively made in Hooghly, Howrah, Murshidabad and Balasore, and is still made in a small scale at Shahbazar in Dhaniakhali, at Neala in Pundooa, at Mainah in Howrah, at Balasore, and at Mahanad and Gossainmalpara (Hooghly). The first paper mill was started in India about 1851 at Serampore in Bengal by the Rev. Missionary Marshman. The Bally Paper Mill was next started about 1867. Both these mills are now closed. The Indian paper mills are mostly dependent on Government orders. To-day there are eight paper mills in India with a capital of about fifty lacs of rupees. In Bengal there are three paper mills, namely, the Titaghar Paper Mill started in 1884, the Kankinarah Paper Mill and the Bengal Paper Mill at Ranigunj. The remaining five mills are:—The Scindhia Paper Mill at Gwalior started in 1880, the Girgaum Mill at Bombay, the Surat Mill and the Reay Paper Mill at Poonah, and the Lucknow Mill started in 1880. Except the three Bengal mills the remaining five paper mills of India are entirely under Indian management.

The Upper India Couper Paper Mill Company at Lucknow having one machine for making "badamis" has a capital of eight lacs of rupees employing seven hundred hands daily under the management of Mr. B. Sinha and producing more than nine lacs of rupees worth of paper annually. This mill supplies the Government about 4000 tons of paper per year. The Titaghar Paper Mills Company have secured contracts from Government of more than 4000 tons of paper per year for three years from 1909.* The statistics of



*Paper nest of Tree-wasp.*

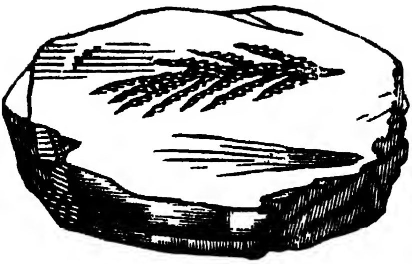
1909 shows that more than ninety lacs of rupees worth of paper was imported into India

The insect wasp is the paper maker of Nature, and with the paper it makes it builds its nest. Like the wasp the Brazilian ants and the South African ants and the termites also construct elaborate nests of paper on trees. If mankind had heeded to the teachings of Nature, the art of paper-making would have been invented long before the Chinese discovered it.

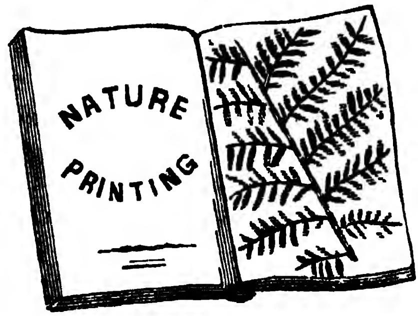
* This Company turns out 15,000 tons of finished paper with their eight paper-making machines, and employing about 2,500 Indian hands.

The Paper Nest of Brazilian Ant

he impressions on leaves and ferns in the various ɔal deposits foreshadowed the art of printing and the odern nature printing of vegetable foliage. The

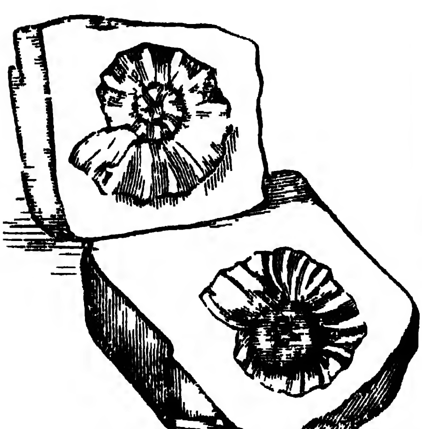


*Ferns in coal bed.*

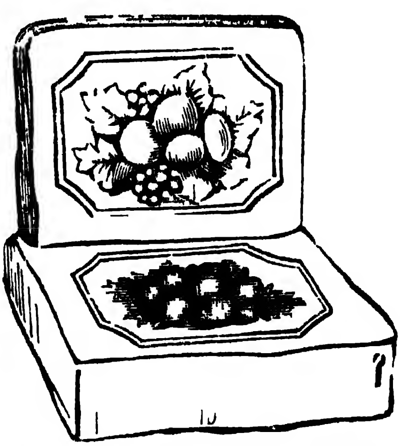



*Nature-printing.*

ıell cast in chalk deposit and other geological strata ɔreshadowed the art of plaste casting. In short, the riting materials—pen, ink and paper—and the arts



*Shell-cast in chalk.*



*Cast in Plaster of Paris.*

f writing and printing had all been long suggested by r derived from Nature.

## The Manufacture of Paper.

The Indian paper mills do not use wood-pulp for the manufacture of the cheapest paper. The following are the different handling process in the manufacture of paper from (1) rags, (2) Bhabar grass, (3) hemp cordage and (4) old paper, as is done in the Couper Paper Mills at Lucknow,—*viz.*, Disinfecting the rags in air-tight chambers by means of a disinfecting liquid or gas Boiling, washing, breaking and draining the beaten pulp by a hydraulic extractor or a centrifugal machine. Bleaching, beating, blending and loading the pulp by the addition of Kaolin or China clay or sulphate of lime, and finally sizing with alum and resin soap and then converting the fine pulp into paper by means of a machine containing drying cylinders and felt drawing rolls from 24 to 36 inches in diameter. The paper-making machine of *Messrs. James Bertram & Son* has a high reputation for the manufacture of paper.

*The process of manufacture.*—The rags are collected from the streets and dust bins by rag-pickers and sold to the rag-merchants who sell them to the paper manufacturers. The first process of cleansing the rags is done by a dusting engine containing a large circular wire sieve. The rags having been sorted are taken into the mill and put into a large boiling trough or cistern containing running water from a tap. The cistern contains a cylinder fitted with rows of iron-spikes, and this is made to whirl round with great rapidity, by which process the rags are torn and thoroughly masticated and reduced to a pulp. The greasy matter of the rags are now removed by the alkaline earth added to the water in the cistern or

ıiled under steam pressure. After the material is operly broken, the stuff is run into large vats and e pulp is pressed by a hydraulic extractor or a ntrifugal drainer. The colour of the pulp is now eached by the addition of chloride of lime which nders the pulp perfectly white. The pulp is now n down into large stuff-chests and allowed to ttle for some time and again washed thoroughly to nove the bleaching powder, after which it is again rown into another masticating machine or beating gine to reduce the stuff into a still fine state of vision and to prepare it for its passage through the ainers and on to the wire-cloth of the paper machine. neral matter such as Kaolin or China clay or sulate of lime is now added to close up the pores of e pulp. For coloured paper a little colouring atter is added, and for white paper a little indigo added. Paper is now made in continuous or ends length by means of a large paper-making machine ntaining two sets of drying cylinders and smaller inders of felt drying rolls from 24 to 36 inches in meter, and the smoothing rolls which discharge e moisture with which the felts are impregnated m the damp paper. The pulp having been pumped o the supply box is run over wooden troughs or ıd tables to allow the impurities to settle. Now it sses on to the strainer plant. The latest improvent in the strainer plant is the "White's Patent cillating Strainer" which is best suited for passing ge quantities of pulp and producing very clean per, the dirt being automatically removed. From "strainers" the pulp passes on to the endless e-cloth of the paper machine where the surplus ter is removed. A vibrating motion is now given to

the machine to intertwine the fibres of the pulp in order to give strength to the sheet of paper. Being subjected to the pressure of the couch and the press-rolls, the web of the paper is now formed and then laid on to the drawing cylinders which gradually take off the moisture and cause the web of paper to dry. The web is now made to pass through one or more sets of calendar rolls according to the finish or surface of the paper desired. The web is next wound into finished reels of paper at the end of the machine.

## The Manufacture of Paper from Wood.

From the forest timber logs are cut up into small cubes which are crushed by powerful rollers and boiled by high pressure steam for several hours in a solution of soda or sulphuric acid. The chemical dissolves a considerable quantity of the resinous and useless constituents of the wood and softens the fibres. This pulp is now made into sheets of light brown card-board and sent to the paper mills, where paper is manufactured from it by the same process as from a rag. It should be borne in mind that more than 80 per cent. of paper used in the world is made of wood-pulp. The world's consumption of paper to-day is about 8 million tons a year, and of this nearly 6½ million tons are made of wood-pulp. The source of paper from bamboo wood-pulp is as yet untouched in India. The pulp-making possibilities of the Himalayan Spruce and Silver Fir and other trees according to the opinion of Mr. William Raitt, the expert cellulose chemist, are commercially very great, while as forest produce they are of no value. So there is a great future for the Indian Paper Mills if

they utilize the cheaper wood-pulp for the manufacture of paper on the modern European or American method.

## The Steel Pen—its History.

*The history of its manufacture.*—The reed-pen was superseded in Europe in the Christian era by the quill pen, for which the pen-knife was first invented, then the pen-cutter machine was devised, then followed the quill nibs, the barrel steel nibs and lastly the steel nibs. From the sixth to the eighteenth century the quill pens formed the principal writing instrument in Europe.

The metallic pens were first introduced in the year 1803 in England, but up to 1830 the goose quill was in general use, when it began to disappear gradually.

*Joseph Bramah* in 1803 invented a machine for cutting out quill nibs from goose quills. *Mr. Wise* first made the barrel steel nibs inserted in a goose quill-holder in the same year in England. The barrel steel nib was made in imitation of the reed and quill pens and shaped entirely by hand. A flat piece of steel was formed into a tube and filed into shape by the hand, the joint of the two edges forming the back central slit of the pen. These costly barrel nibs were at first used for several years. In Birmingham, *Mr. Samuel Harrison*, a blacksmith, made a barrel steel pen for Dr. Priestly about the year 1780. *Mr. Fellows*, a blacksmith of Sedgley, Worcester, improved it. Harrison's barrel steel nibs were then sold at 5 shillings each and Fellow's barrel nibs at 1½ to 2 shillings each.

In 1808 *Bryan Donkin* took out his first patent for a barrel steel pen.

*Charles Watt* in 1818 took out a patent for a thickly-coated gold quill pen—the precursor of the modern gold pen.

In 1822 *Hawkins and Mordan* obtained a patent for tortoise shell or horn nibs tipped with diamond or ruby.

The modern metal nib is the result of much experiment. With the introduction of vertical fly screw press and the foot-drop press in 1825, various forms of presses were devised for cutting out the "blanks" and for marking, embossing, bending and slitting the metallic pens. Formerly in the barrel steel pens which formed the holder and the pen in one piece, there was much wastage of material when a pen was finally worn out by use. Economy, therefore, suggested to make the barrel portion separate from the nib portion. From this time the *quill-holders* were discarded and wooden and other *pen-holders* introduced. The light and durable porcupine pen-holders of that time suggested the modern light vulcanite pen-holders. The nib-making business and the pen-holder manufacture became gradually separated from each other.

*Perry* in 1830 having got the idea of Bramah's quill nibs took out a patent for the first metal nib.

Harrison's partner *Josiah Mason* further developed the metallic pen industry on the line of Perry's patent.

*Joseph Gillot* in 1831 took out a patent and was the first successful pioneer of the nib industry. At that time steel pens were sold at eight shillings a gross. To-day we can get them at four annas a gross.

In 1853 *Charles Goodyear*, the inventor of the vulcanised rubber and vulcanite, tried to make pens out of vulcanised rubber.

In the year 1856 *Henry Peters* attempted to make tortoise shell nibs.

*Scully and Heywood* in 1855 obtained a patent for using aluminium for the manufacture of nibs.

*Bewicke and Blackburn* in 1857 tried to make nibs of glass with two glass nib portions set in a metallic frame

In 1859 *Edward Cubbolt* made pens from strips of cane and reed.

In 1861 *Evans and Concanean* made pens from horn, and *George Leslie* in the same year used gutta-percha and vulcanite for the manufacture of nibs.

In 1863 a patent for *aluminium* bronze nibs was taken out.

In 1876 a *Mr. Louis* obtained a patent for a 16-carat gold nib covered with rubber and tipped with iridium. Like the gold quill pens of *Charles Watt* in 1818, this is the second attempt to make a solid gold pen.

In 1822 *John Isaac Hawkins* discovered the advantage of iridium fragment to the point of a gold nib. He experimented on this for thirty years and was about to give it up when on hearing the failure of one *Mr. C. W. Robinson* to make a pen of iridium he again experimented on it, overcame the difficulty and solved the problem of slitting the iridium-tipped nib by means of a high-speed lathe and using diamond dust and oil on a rapidly revolving thin disc of soft copper. To England thus belongs the honour of originating the iridium-tipped gold nibs. America by labour saving machinery improved its manufacture. To-day New York practically supplies the bulk of gold pens used all over the world, and Birmingham supplies the steel pens. *Messrs. Mordan of London*,

and *Willey* of Birmingham, were the pioneers of the gold pen manufacture in England.

Thus for a century, it will be seen, how the larger cerebrums of the inventors, one after the other, carried on their campaign of ingenuity, skill and perseverance for bestowing on the world the little peaceful instrument "mightier than the sword" which had been destined in conjunction with the printing press to bring on an era of universal "peace on earth and good will toward men," and what Victor Hugo said of the pen and the sword, "Ceci tuera cela," this will kill that, has been fulfilled.

## The Progress of the Nib Industry.

The steel pen manufacture was at first entirely a British industry and monopoly. Birmingham was the chief seat of the world's supply. About the year 1800 A.D., it is said that Perrigrin Williamson, a Baltimore jeweller, made the first attempt in making steel pens in America; but it was not until 1860 that steel pens were manufactured in large quantities by mechanical processes in the United States of America. In 1851, one Birmingham firm alone employed five-hundred persons, mostly females, having an annual output of fifteen crores of steel pens. In 1899, there were twelve large steel pen factories in Birmingham, one in Germany, one in Austria, one in France and one in America. In 1906, there were twenty-five steel pen factories in the world, of which, thirteen were in Birmingham and the rest in Germany, Austria, France and America. In Birmingham alone four-thousand women and girls and six-hundred men and boys are engaged in the steel pen manufacture,

and three-hundred women and girls employed in making the paper-boxes—the whole industry thus consuming about twenty tons of steel sheets weekly and producing forty crores of pens per week. The world's consumption of steel nibs to-day amounts to twelve millions of gross annually. In the United States in 1906, there were fifty establishments engaged in the steel pen, the gold pen, the stylo-pen and the fountain pen industries, employing four-thousand hands, mostly women and girls. The total annual value of the American products is sixty lacs of rupees comprising ten lacs of rupees for thirty crores of steel nibs, twenty lacs of rupees for ten lacs of gold nibs, and thirty lacs of rupees worth of stylo and fountain pens.

## The Nib-making Plant.

The nib-making plant consists of the following machines:—

1. The annealing furnaces and iron boxes.
2. The shearing press.
3. The rolling mill.
4. The micrometer gauge and specimen plates of the standard thickness of the pen to be manufactured.
5. The "blank" cutting hand-fly vertical screw press with punches and hollow beds.
6. The name-marking foot-drop frame press and punches.
7. The embossing foot-drop frame press.
8. The piercing and side-slitting foot-drop frame press with punches and beds.
9. The nib-raising hand-fly screw press with punches and curved dies.

10. The tempering pans, cylinders and furnaces.

11. The scouring drums and polishing materials forming a shaking mill, worked by power.

12. The polishing emery wheel bobs and holding sticks machine, worked by power.

13. The pen-slitting hand-fly vertical screw press with razor-like double cutters and rests.

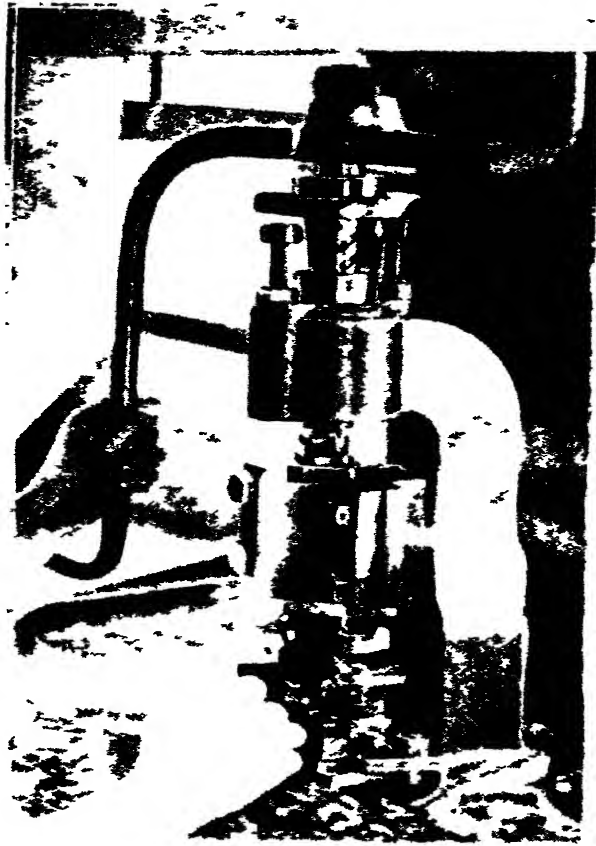
14. The potting drums and iron cylinders.

15. The electroplating outfit, if required, worked by a dynamo.

## The Manufacture of Steel Pens.

Simple as it appears at first sight, the nib is not a simple affair to make. It has already been mentioned how important the industry is and how very interesting is its development from a very small beginning. Let not the reader think that the sheet of steel goes in one end of a machine and the finished pen drops down from the other end. Great care and constant supervision are required in its manufacture

The steel pens are manufactured from sheets of best crucible steel imported from Sheffield or from Sweden. There are at least twenty to twenty-four different handling processes in the manufacture of a nib. The crucible steel sheet 19″ wide, 5 ft. long, and ·023″ in thickness. is cut transversely by a steam shearing press into small slips or flat pieces 19″ long and about 4″ broad, *i.e.*, wide enough to cut two pens breadthwise. They are now put in closed iron boxes, mixed with charcoal dust and annealed or softened in muffle furnaces by heating them to redness for several hours, and cooling them again slowly. They are pickled or cleaned and polished by dipping them in dilute sulphuric acid. The strips are



Piercing the Pens.

Marking

Raising the Pens.

Tempering the Hardened Pens.

The Slitting Machine.

then reduced to the thickness required by the process of cold rolling, *i.e.*, passing the flat pieces through the rolling mills several times. This process reduces the thickness to ·009 of an inch, by which the original 19″ strips are stretched out to 50 inches. By means of a mechanical process the "blanks" or "flats" are then cut by the hand-fly vertical screw press containing a punch and a hollow die. When all the blanks are punched out at one edge of the steel sheet, it is quickly reversed and the other edge stamped out in a similar manner. From forty to forty-five thousand blanks can be cut by one operative in a day of eight hours. Each blank or flat piece is annealed once more and then stamped with the maker's name and design by means of two separate marking and embossing foot-drop frame presses. Twenty-thousand pens can be marked in this way by one skilful operator in a day. The central hole and the side-slits are now cut by another foot drop press containing punches and beds. The side slits give elasticity to the nibs, and the central "pierce" or hole gives elasticity as well as increased ink-holding capacity to a nib. Each hardened blank is again annealed to make it pliable. The blank is now curved or raised by a hand-fly vertical screw press containing a curved die and punch, in order to give the nib its concave form. On moving its handle the screw descends and forces the flat pen down upon the curved die. Each blank is removed from the screw press not by the laborious and slow process of the hand but by means of a compressed air machine. The curved blanks are now hardened by plunging them in hot oil. The oil is removed by a centrifugal-force machine, and the blanks are put in a boiling lye containing soda and water in order to

remove the grease on the nib. Then the pens are dried in saw-dust and tempered very carefully by placing them in closed revolving shallow pans and iron cylinders over a charcoal fire. When the nibs are seen to assume a blue colour it denotes that they are properly tempered; they are then put aside and allowed to cool slowly Scouring or cleaning and polishing process in the shaking mills now follow by putting the nibs in various revolving drums containing wet and dry polishing materials such as sand and saw-dust, fire clay, emery flour and water. In order to facilitate the easy flow of ink in a nib, the straight and cross grindings of the nibs are now done in the revolving emery wheel bob-polishing machine. About twenty-five pens per minute can be grinded by an expert straight-grinder and twelve pens per minute by a cross-grinder. The straight and cross grindings may also be performed by an automatic grinding machine at the rate of twenty-four a minute. Finally the most important process of slitting the pen, which has already been hardened, tempered and curved, is done by means of the hand-fly vertical screw press having a most delicate pair of very hard and razor-like keen cutters and rest, the pen being held in place by the guide rest over one blade of the cutter. The slitted pen points of the nibs are now rounded and smoothed in revolving cans containing polishing materials, and finished by the process of "potting," *i.e.*, colouring them brown or blue by a gentle heat. Then follows the process of varnishing with lac to preserve the nib from the effects of atmospheric air. Each completed pen is now examined carefully and the defective ones rejected. The pens are counted by means of weighing, after which they are boxed and

labelled. Nearly 20 per cent. of the pens made are thus rejected by the process of expert examination. The cheap pens are made from ready-made sheets without annealing and the preliminary process of cold rolling. If the pens are to be electroplated with bronze, silver, gold, copper or nickel then they go to the electroplating department. To-day there are about two-thousand different forms and varieties of steel pens in the market.

*The summary of the manufacturing process* is as follows, in order of succession :—

(1) Cutting into thin strips, (2) annealing, (3) pickling, (4) cold rolling, (5) blank-cutting, (6) annealing again, (7) marking name, (8) embossing design, (9) side slitting and piercing, (10) annealing again, (11) raising the nib, (12) hardening in oil, (13) removing the grease, (14) tempering, (15) scouring and polishing, (16) straight and cross grinding, (17) slitting the nib, (18) smoothing the point, (19) potting, (20) varnishing, (21) examining for defects, (22) boxing and labelling, and (23) plating where it is found necessary.

## The Manufacture of Gold Pens.

In order to make 14-carat gold which is generally the suitable composition for the manufacture of gold nibs, the first step in the process of manufacture is to alloy the ingots of pure gold with suitable proportions of silver and copper. The 14-carat ingot thus made is then rolled into thin plates through the roller mills, and the blanks are punched out, as in the case of steel nibs, by means of a vertical hand-fly screw press. The tip of each blank is hollowed out and a fragment of iridium is put into it by the aid of a magnifying

glass. By means of a blow-pipe the gold is then brazed or fused around the non-fusible iridium. Each blank is now passed between the rollers, but the iridium-tipped point is not touched as it is protected under a hollow recess of the roller. The tempering of the gold pen is done by hammering with the aid of a steam-hammer. The blank is then cut a second time by the fly-press when it assumes the full shape of a nib. The point is then ground carefully with emery wheel and oil. The blank is now raised or curved by means of a screw press. The slitting of the iridium-tipped gold pen is done by a rapidly revolving thin disc of copper dipped in a reservoir containing fine emery and water. The gold nibs do not require side slitting or " piercing " generally. The slitted nib is now gripped in a kind of holder, carefully ground and polished on thin revolving iron disc with emery and oil. The underside of the pen may be roughened, if necessary, by means of a sand-blasting machine, by which process the easy flow of ink is facilitated. It is to be borne in mind that the various grinding and polishing operations cause a loss of not less than 15 per cent. of gold from which only 6 per cent. of waste is usually recovered

## The History of the Fountain Pen.

As lead pencils and paper are cheap and convenient, they have become rivals of the slate and slate pencils in schools where they are now being gradually discarded with. Commercial correspondence is to-day type-written. The type-writer, though a rival, yet by increasing the volume of correspondence has also helped the nib industry. The time-saving stylo and

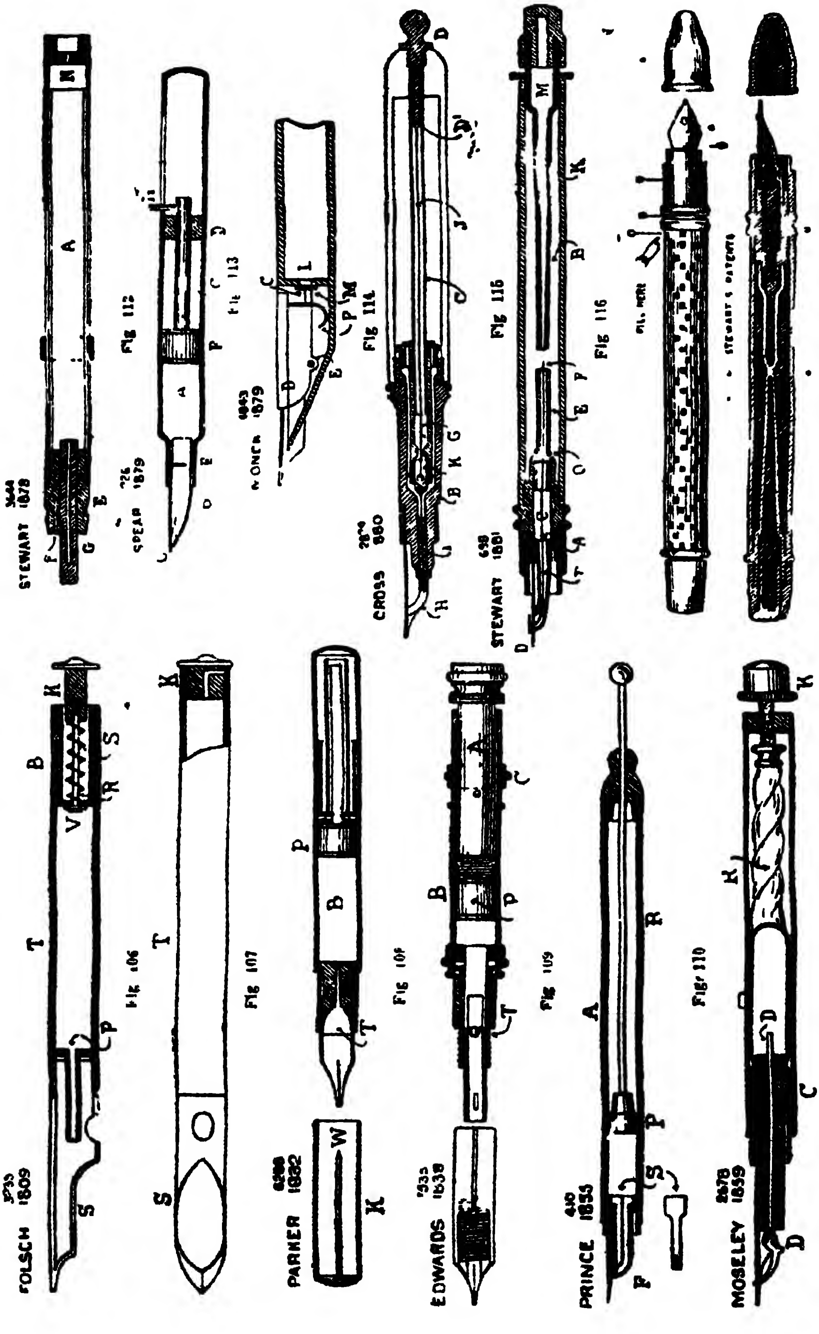
fountain pens are also great rivals of the steel pens. Simultaneously with the invention of the metallic nibs attempts were made to make *reservoir-nibs* in order to prevent the frequent dipping of the nib in the ink-well, and thus the reservoir fountain pens for the pocket have finally come into use. At first the fountain pens were made of an easily compressible reservoir of ink from which the ink was conducted to the nib by pressure between the finger and the thumb. The air-vent and the vent-tube were then added to the barrel, and the reservoir gradually made rigid. The ink was conducted by a suitable feed placed under the nib or above it, or on both sides of it, and the air was conducted to the barrel through a duct or groove in the feed. Separate single air-vent at the bottom of the feed was then adopted, and finally double air-vents were added. The patent office records show that more than 155 patents have been taken out within the last one hundred years. The first mention of a fountain pen is found in Hutton's Mathematical Dictionary published in the year 1795.

1. *Frederick Bartholomew Folsch* obtained the first patent for a fountain pen in 1809, which had a spring valve air-tube at the top of the barrel. (Fig. 105.)

2. *Joseph Bramah* in 1809 took out a patent in England for a fountain pen with a compressible reservoir controlled by pressure of the finger and thumb, and having also a self-filling mechanism by means of a sliding piston at the top of the barrel.

3. *John Scheffer* in 1819 got a patent for a compressible reservoir and self-filling fountain pen from which the flow of the ink was controlled by pressure exerted on a lever.

4. *James Henry Lewis* patented in 1819 a fountain



FOLSCH 1809
Fig 106
Fig 107
PARKER 1832
Fig 108
EDWARDS 1838
Fig 109
PRINCE 1855
Fig 110
MOSELEY 1859
STEWART 1878
SPEAR 1879
Fig 112
Fig 113
Fig 114
CROSS 1880
Fig 115
STEWART 1881
Fig 116
STEWART'S PATENTS

pen which was made of a compressible thin barrel of quill in which the ink was made to flow to the nib by pressure of the finger and thumb.

5. *George Poulton* in 1827 received a patent for a fountain pen having a valve and a weight inside the barrel by which the ink was pressed into the nib.

6. *John Joseph Parker* in 1832 procured a patent for the first self-filling fountain pen having a piston in the holder operated by a screw stem and a nut at the top of the barrel. When the piston was drawn up by rotating the nut, the reservoir was filled from an ink-pot and the ink was conducted to the nib by pressure of the contrary motion of the thumb nut.

7. *John Edwards* in 1838 secured a patent for a telescopic fountain pen having air-vent at the top and a self-filling mechanism worked by means of a hollow tubular piston. (Fig. 108.)

8. *Henry Columbus Hurry* in 1852 obtained a patent for a non-leakable fountain pen having a valve mechanism.

9. *W. R Bartolacci* in 1852 took out a patent for a compressible reservoir and self-filling fountain pen having an elastic rubber bulb inside the barrel actuated by a pressure knob and an under-feed to the nib, and also provided with a self-filling piston and a screw cap to prevent leakage.

10. *Newill A. Prince* in 1855 got a patent for an improved fountain pen provided with a self-filling piston encased for the first time within a *vulcanite barrel* and having a tubular under-feed covered by a flat spring for conducting the ink to the nib by pressure on the nib in the act of writing. (Fig. 109).

11. Even woman inventor made attempt to im-

prove the fountain pen, and *Susan E. Taylor* in 1858 secured a patent for a fountain pen.

12. *Walter Moseley* in 1859 patented a compressible and self-filling reservoir fountain pen provided with a soft India Rubber tube inside the barrel and fixed to a self-filling screw cap, which by twisting and untwisting the rubber tube sucked or ejected the ink as desired, and having a pressure knob for the finger to push out the ink to the nib, while writing. (Fig. 110).

13. *Joseph Maggs* in 1863 patented a fountain pen having a flexible tube of rubber reservoir inside the barrel in which the ink was made to flow to the nib by pressure of finger and thumb.

14. *John Darling* in 1867 received a patent for a compressible rubber tube-holder fountain pen having a tubular under-feed and two spring pressure knobs attached to the rubber tube reservoir, in which the knobs being pressed conducted the flow of ink to the nib or filled the pen with ink when empty.

15. *John Butcher* in 1870 procured a patent for a compressible reservoir self-filling fountain pen like that of Moseley's of 1859.

16. *Messrs. Rheinberg* in 1870 obtained a patent for a flexible reservoir fountain pen having a knob pressed during writing.

17. *Stewart* in 1878 took out a patent for a suction self-filling and compressible reservoir fountain pen having an elastic tube inside a barrel of metal or vulcanite and provided with a grooved prong underfeed. The barrel was filled with ink by blow-fill suction mechanism as in a modern blow-fill fountain pen introduced by the Jewel Pen Co., London.

18. *S. Fox* in 1878 got a patent for a long compressible rubber tube connected at one end with an

ink-pot placed high and at the other with the barrel of the fountain pen. In this the ink was supplied by the action of gravity to the nib, and the pen was made portable, if desired, by attaching the ink-pot portion to one's body by means of a hook.

19. *R. Spear* in 1879 patented a self-filling fountain pen having a piston operated by a projecting pin and a tubular feed to the nib. (Fig. 112).

20. *A. T. Cross* in 1880 secured a patent for a complicated fountain pen admitting air at the lower end, and provided with a tube clearing wire spindle, vent-plug and a tubular feed to the nib. (Fig. 114).

21. *F. W. Monk* in 1879 received a patent for an ink controlling feed by means of a spring valve mechanism which opens in th act of writing. (Fig. 113).

22. *A. Tust* in 1880 procured a patent for a self-filling fountain pen like that of John Scheffer, which was provided with a piston and piston rod. The piston also acts as a pressure valve to force the ink into the nib, while writing.

23. *W. W. Stewart* in 1881 again obtained a patent for a caligraphic fountain pen having a vent-tube and air-vent placed at the top of the barrel as in a stylo-pen and fitted with a capillary wire inside the writing section to conduct air into the barrel. This pen was manufactured by Messrs. Mabie, Todd, and Bard of New York and introduced into England by Mr. Robinson, who also first introduced the American stylo-pen invented by A. T. Cross. (Fig. 115).

24. *Jackson* in 1881 took out a patent for a flexible reservoir fountain pen having a screw plug at the top which by twisting and untwisting filled the barrel with ink exactly like that of Moseley.

25. *T. R. Hearson* in 1881 got a patent for a foun-

tain pen like that of W. W. Stewart, only slightly modified, having air-vent and vent-tube at the top of the barrel and fitted with a barrel nib. (Fig. 117).

26. *Poznanski* in 1881 patented a fountain pen in which the top of the barrel is fitted with a soft rubber tube which forces the ink, while writing, by pressure of the finger and thumb, and also fitted with a tubular feed to the nib.

27. *Sparling* in 1881 received a patent for a fountain pen having a self-filling sliding rod piston which also presses the ink to the nib as in the Scheffer's pen.

28. *W. W. Stewart* again in 1882 secured another patent in which the feed has a projecting cord or straw to conduct ink like a wick to the nib, and the barrel is glazed inside like that of Poznanski. (Fig. 116).

29. *Colin* in 1882 procured a patent for a compressible reservoir self-filling fountain pen filled by suction on being compressed by a knob, or by twisting by means of a pin placed at the top of the barrel as in the pen of Moseley or that of Jackson.

30. *Hughes and Carwardine* in 1882 obtained a patent for a new method of conducting ink to the nib by an India-rubber bag—the pressure on the nib while writing caused the ink to flow to it and the air was admitted at the top of the barrel through the conical plug. (Fig. 119).

31. *R. Enright* in 1882 took out a patent for a fountain pen with a vent-tube and air-vent placed at the top of the barrel and having a barrel nib. The pressure on the nib in the act of writing caused the flow of ink as in the pens of Hughes and Carwardine.

32. *Osborn* in 1882 secured a patent for a fountain pen which has two valves at the two ends of a pin or wire inside the barrel. The pressure on the nib in

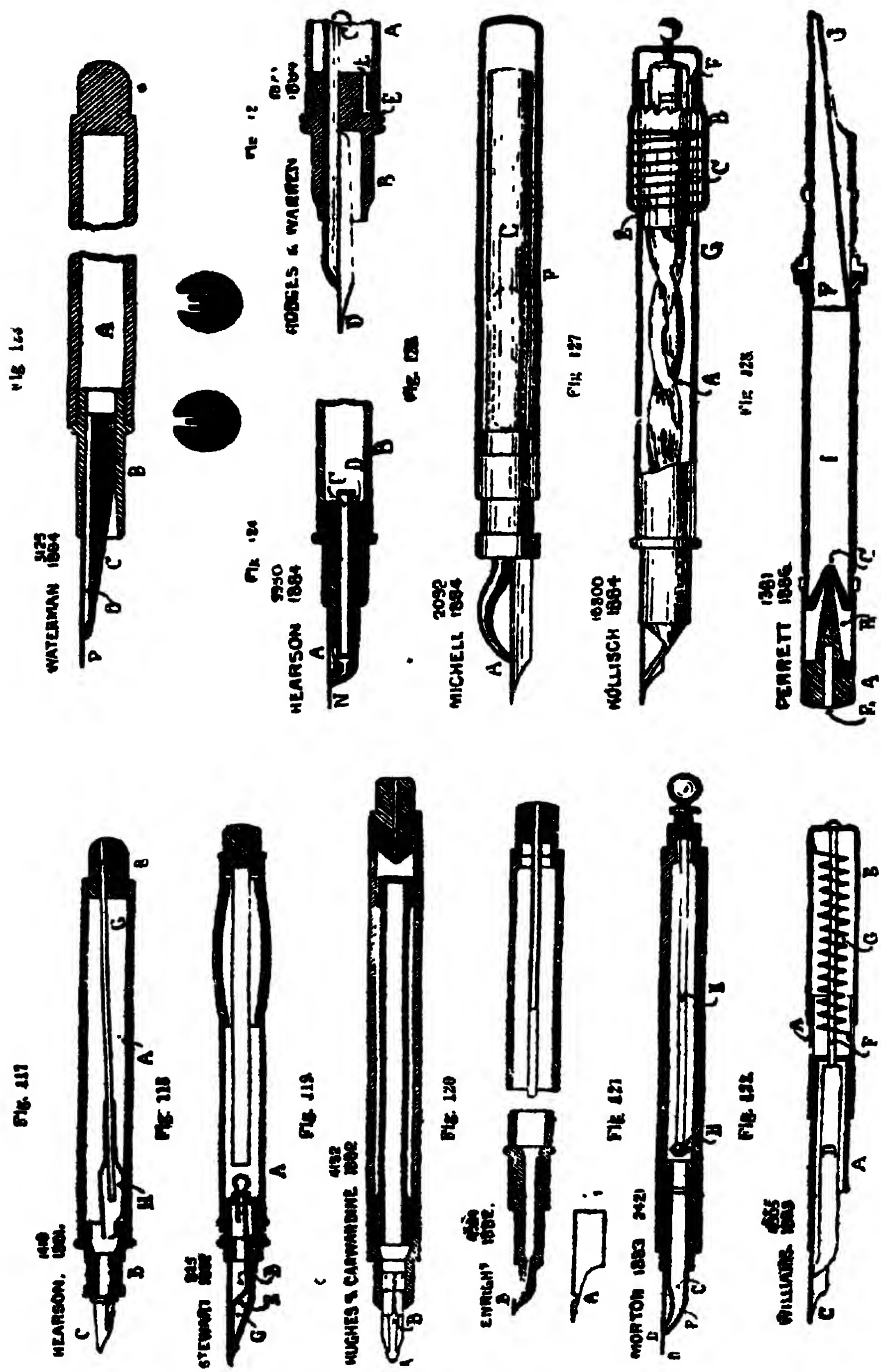


Fig. 117
HEARSON.
Fig. 118
STEWART
Fig. 119
HUGHES & CARTWRIGHT 4132 1882
Fig. 120
ENRIGHT
Fig. 121
MORTON 1883
Fig. 122
WILLIAMS
Fig. 123
WATERMAN 5125 1884
Fig. 124
HEARSON 3950 1884
ROBERTS & WARREN
Fig. 126
MICHELL 2092 1884
Fig. 127
WÖLLISCH 16800 1884
Fig. 128
PERRETT 1361 1886

the act of writing opens both the valves so as to admit air at the top and the simultaneous flow of ink below to the nib.

33. *Robert Shaw* in 1883 got a patent for a fountain pen in which there is the first mention of the air being admitted through the lower end of the barrel.

34. *J. Morton* in 1883 received a patent for a non-leakable self-filling fountain pen for the pocket, having a conical piston rod as in the modern " Onoto " pen and a tubular feed with a single air-vent in a depression at its top. (Fig. 121).

35. *Bertram* in 1883 procured a patent for a fountain pen which has a tubular air-tube piston passing through the top of the barrel, like an "Onoto," and fixed to a screw plug which admits air and ink to the nib on unscrewing, and closing the ink passage by screwing the plug when the pen is not used.

36. *Vale* in 1883 obtained a patent for a fountain pen that has a screw cap self-filling reservoir inside a barrel and an under-feed to the nib like that of Moseley's of 1859.

37. *Williams* in 1883 took out a patent for a fountain pen which is merely like a self-filling reservoir nib holder and not a portable fountain pen suitable for the pocket. (Fig. 122).

38. *L. E. Waterman* in 1884 took out a patent for a fountain pen that has a grooved prong under-feed to the nib in which the ink is fed to the nib by gravity and capillarity and the air drawn into the barrel along the fissures of the grooved prong-feed. (Fig. 123).

39. *T. A. Hearson* in 1884 patented a fountain pen which has a tubular under-feed with two distinct passages, one for admitting air and the other for

allowing ink to the nib. This is a fountain pen having a tubular feed with a single air-vent below.

40. *Hodges and Warren* received a patent in 1884 for a fountain pen which has a slitted-up top-feed over the nib passing through the whole length of the barrel inside. (Fig. 125).

41. *E. B. Michell* in 1884 secured a patent for a fountain pen having a flexible rubber bag from which the ink is conducted to the nib by pressure of the finger and thumb during the act of writing through the top-feed mechanism passing over the nib. (Fig. 126).

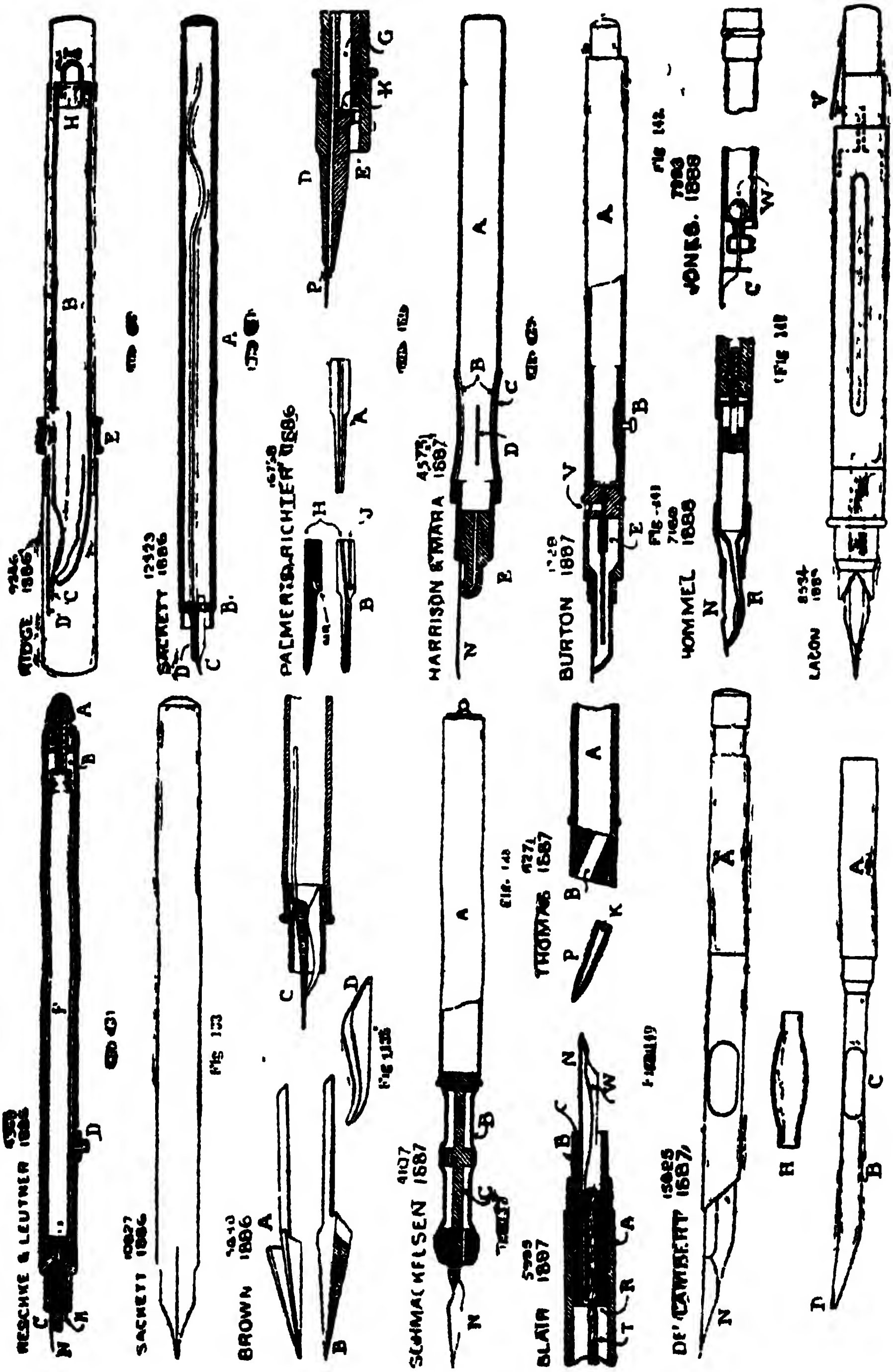
42. *Kollisch* in 1884 procured a patent for a fountain pen having a rubber tube reservoir from which the ink flows to the nib by twisting and provided with an under-feed tubular mechanism to the nib.

43. *Bertram* in 1885 again took out a patent for a fountain pen which has a grooved elastic prong-feed, conducting the ink to the nib in the act of writing, the air being admitted through the serrated edges of the prong-feed as in that of L. E. Waterman.

44. *Brown* in 1886 obtained a patent for a fountain pen having a top-feed grooved mechanism and a separate tubular air inlet through the feed bar.

45. *Perret* in 1886 took out a patent for a fountain pen having a screw cap tapering plug at the top of the barrel, and the air valve and the tubular feed under the nib. (Fig. 128).

46. *Reschke and Lentner* in 1886 got a patent for a fountain pen having a flexible rubber ink reservoir provided with a self-filling mechanism by means of a screw rod at the top of the barrel and with a pressure knob to deliver the ink to the nib through a tubular under-feed like that of Moseley (1859). (Fig. 129).


RIDGE 1886
SACKETT 1886
PALMER & RICHTER 1886
HARRISON & O'MARA 1887
BURTON 1887
HOMMEL 1888
JONES 1888
LACON
RESCHKE & LEUTNER
SACKETT 1886
BROWN 1886
SCHMACKELSEN 1887
THOMAS 1887
BLAIR 1887

47. *Ridge* in 1886 patented a fountain pen having a glass reservoir pointed at one end with a projecting wick to conduct ink to the nib and a self-filling plug at the top, which is pushed down or raised by means of a separate rod in the act of filling. (Fig. 130).

48. *G. Sackett* in 1886 received a patent for a fountain pen which is an exaggerated metallic barrel pen, the ink flowing by the slit of the nib by pressure exerted in the act of writing. Sackett's pen contained a sliding plug with a single air-vent and a whole length grooved feed bar, the ink being conducted to the nib by the top-feed bar placed over the nib.

49. *Brown* in 1886 secured a patent for various grooved triangular feed bars placed over and below the nib similar to the modern twin-feed bars.

50. *Palmer and Richter* in 1886 procured a patent for improvement in feed bar having a grooved prong under-feed and a single air-vent channel. (Fig. 134).

51. *J. Schmackelsen* in 1887 obtained a patent for a fountain pen having a reservoir, both rigid and flexible, the ink being conducted by pressure of finger and thumb while writing. (Fig. 135).

52. *Harrison and Mara* in 1887 got a patent for a fountain pen that had a flexible and rigid ink reservoir, like that of J. Schmackelsen, but having a tubular feed. (Fig. 136).

53. *Blair* in 1887 took out a patent for a fountain pen which has a corrugated plug in the writing section with a wooden under-feed and a metal strip. (Fig. 137).

54. *W. E. Burton* in 1887 patented a fountain pen provided with a flexible reservoir tube inside the barrel, and operated by a stud and plate from the exterior. Air is admitted through a separate hole bored on the writing section. (Fig. 139).

55. *W. J. Thomas* in 1887 obtained a patent in which the reservoir is perforated at an angle into which a short tubular feed with a tapering bore is secured, through which the ink flows under the nib. The tubular feed is placed at an angle in order to prevent leakage when the pen is kept on the desk, and the holder is weighted for the purpose to keep the pen in the position indicated. Air is admitted through the top of the barrel. (Fig. 138).

56. *De Lambert* in 1887 got a patent in which the lower portion of the metallic barrel is flexible and curved under a metallic sheath with a slot or opening containing a small sponge inside a rubber sleeve. The pressure of the finger in the act of writing on the rubber sleeve forces the ink through the opening of the tubular feed to the nib. (Fig. 140).

57. *Hommel* in 1888 patented a self-filling fountain pen having a piston in the barrel and a small fine tubular and curved-feed under the nib. (Fig. 141).

58. *G. H. Jones* in 1888 received a patent having a glass tube reservoir drawn to a fine point at one end like a glass pipette and covered at the other end with some elastic material which on being pressed conducts the ink to the nib. The glass barrel is filled by heating the tube and then dipping the point quickly in ink. This pen also contains a weighted disc for closing the ink outlet of the tubular feed when the pen is kept reversed. (Fig. 142).

59. *W. Guthrie* in 1888 procured a patent for a fountain pen in which the pen, on being held with the point upward and then inverted, caused a drop of ink to flow to the nib, and this process is repeated every time to continue the flow to the nib while writing.

60. *E. Lacon* in 1889 secured a patent in which

the reservoir is of glass placed under a slotted protecting barrel. The top of the barrel is provided with a spring valve protecting the air-vent. A sliding ring is placed over the spring to the valve to open or close the air inlet valve as desired. (Fig. 143).

61. *Fry* in 1889 obtained a patent in which the reservoir is closed by a plug and the feed-bar perforated by minute holes placed under the nib. The flow of ink into the feed-bar tube is provided with a plug which screws and unscrews its orifice through which the ink flows to the nib.

62. *Falconnet* in 1889 patented a piston-typed fountain pen in which the piston has a threaded perforation at one end of the piston, through which passes a rod, secured to a cap at the top of the barrel. When this cap is turned the piston rod is also turned to move up and down inside the reservoir. The lower end of the barrel is provided with a tapering tube feed-bar which is slotted under the nib.

63. *Pickhardt* in 1890 took out a patent having a glass or vulcanite reservoir drawn to a fine pipette point, a gauge or woven asbestos being inserted within this tapering point or the tongue of the nib itself projecting under the nib, to facilitate the flow of ink. (Fig. 144).

64. *H. Pearse* in 1890 got a patent for a pen having a tubular plunger inside the barrel and an air-vent at its top protected by a screw plug. (Fig. 146).

65. *Hill and Appleton* in 1890 received a patent in which the reservoir is of guttapercha placed within a metal barrel; it has a hollow tubular feed-bar placed under the nib and is provided with two holes —one for the admission of air and the other for the outflow of ink.

66. *H. Pearse* in 1890 procured a patent in which the writing section which is screwed to the barrel has a valve operated by a lever to regulate the flow of ink under the nib. The top end of the barrel admits air through a long air-vent tube and is covered by a screw cap which closes the air-vent when the pen is not in use.

67. *The Eagle Pencil Co.* of America in 1890 secured a patent in which the reservoir is connected with the barrel by an elastic tube. The feed tube is provided with a swelling or shoulder, which prevents it from slipping too far forward and is slotted for the flow of ink. A folded wire also passes from the feed tube to the reservoir. A grooved prong feed-bar with one or more longitudinal grooves and a saw-cut under the point to render the prong more flexible are also described. (Fig. 147).

68. *Hyde* in 1890 obtained a patent in which the prong-like feed placed on the top of the nib is tubular within the writing section; the flow of ink is conducted by a slitted bore above the nib and the air admitted below the nib through an opening. (Fig. 148).

69. *Robinson* in 1890 took out a patent in which the reservoir is provided with a plug in the writing section to hold the nib. The plug is provided with a groove above the nib in which is also placed a wire or a strip of metal flattened at the tip of the nib, the ink flowing through the narrow space between the wire and the surrounding walls, and also air passing through this space. (Fig. 149).

70. *Shaw* in 1891 got a patent in which the barrel is closed at one end and has two openings at the other end, one for the inlet of air and the other for the out-

let of ink; the writing section screws on the reservoir and has openings corresponding to the inlet and outlet openings. It is also hollowed out to receive the nib part. The nib is covered with a plate between which and the nib the ink flows, air entering through an opening provided.

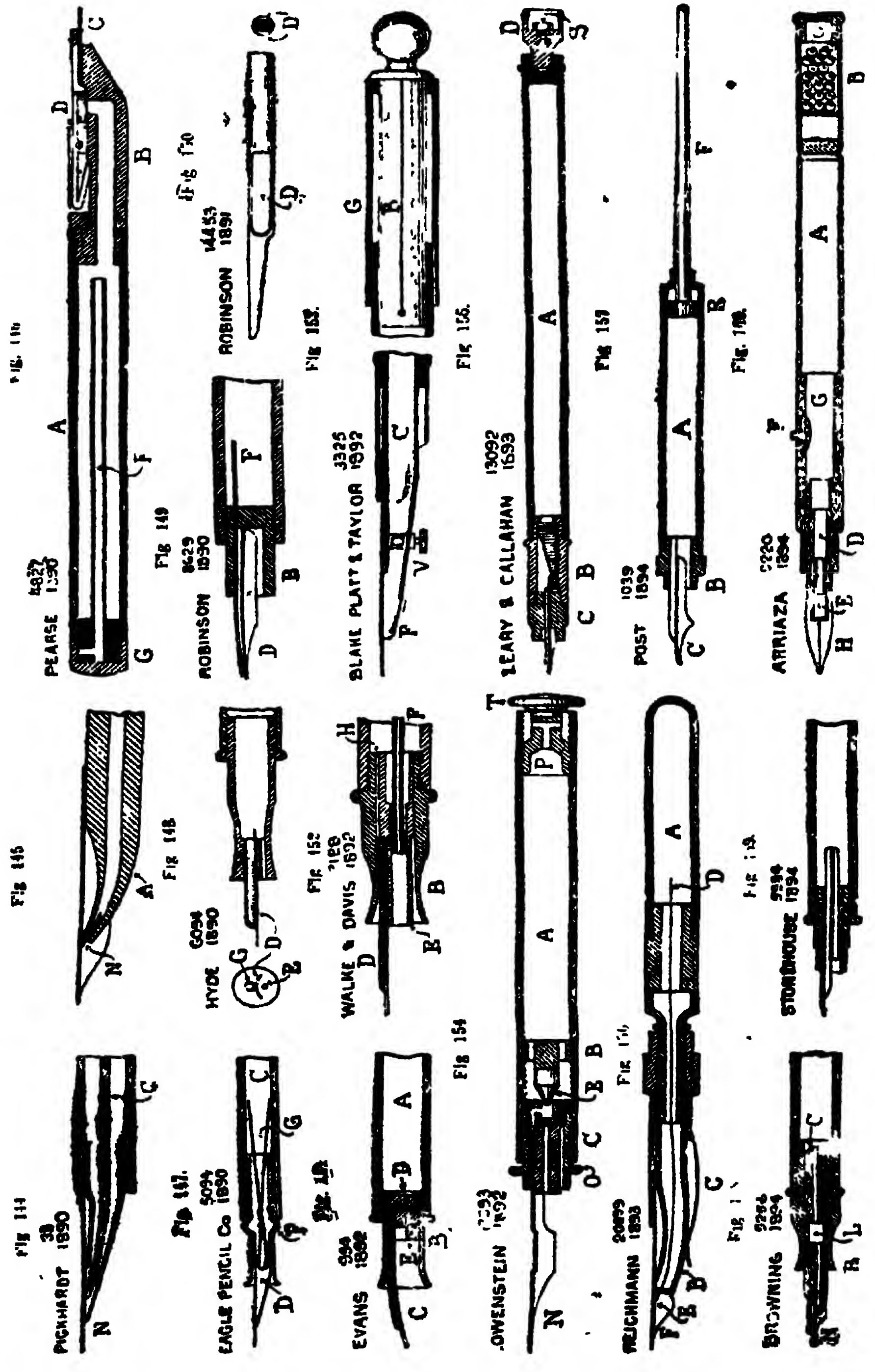
71. *Messrs. Krulis and Adutt* in 1891 patented a fountain pen in which the ink flows to the nib through a tube from the reservoir. This tube may be carried by the valve placed on a rod fixed to a plug fitted in the upper end of the reservoir. An elastic rubber plug or spring forces the plug outward, and thus keeps the valve normally closed.

72. *Mr. Robinson* again in 1891 received a patent with improved feed-bar of solid construction having the sides flattened to allow of the passage of ink from the reservoir to the nib. (Fig. 150).

73. *A. Theodorides* in 1891 secured a patent in which the reservoir is of India-rubber compressible bag closed at one end and having a rigid bent nozzle at the other so adapted as to be in contact with the underside of the nib. In the outer case is an aperture through which the reservoir may be compressed by the finger for filling or supplying ink to the nib.

74. *T. W. Evans* in 1892 procured a patent for a fountain pen having a projecting beak or tongue like top-feed bar, the solid end of which is provided with passages for the outlet of ink and inlet of air. The nib is held in the grooves in the point section and kept in place by a separate small plug. (Fig. 151).

75. *Walke and Davis* in 1892 obtained a patent having a prong top-feed ink conducting arrangement provided with a tubular air-vent trap and a separate fine vent-tube. (Fig. 152).


PICKHARDT 1890
PEARSE 1890
EAGLE PENCIL Co 1890
HYDE 1890
ROBINSON 1890
ROBINSON 1891
WALKE & DAVIS 1892
BLAKE PLATT & TAYLOR 1892
EVANS 1892
LOWENSTEIN 1892
LEARY & CALLAHAN 1893
REICHMANN 1893
POST 1894
ARRIAZA 1894
STONEHOUSE 1894
BROWNING 1894

76. *Blake, Pratt and Taylor* in 1892 took out a patent having a self-filling tubular piston encased in a sliding barrel. The piston is provided with a longitudinal slit to form a tightly-fitting elastic joint when fitted with India rubber. The feed is also tubular and tapered at its end, and having a valve to regulate the ink to the nib. (Fig. 153).

77. *Lowenstien* in 1892 got a patent for a complicated pen having a screw cap air-vent mechanism at the top of the barrel. At the other end of it there are two feed plugs screwed to it. The upper plug has two holes for the passage of ink and a conical projection which enters the opening in the other lower plug. The position of the lower plug containing passages for the flow of ink can be adjusted by turning its milled head projection, by means of which it closes on the conical upper plug or allows the ink to pass to the nib point. (Fig. 154).

78. *W. Higgs* in 1892 received a patent for a self-filling pen having a flexible rubber reservoir inside the barrel attached at one end to a cylindrical piece and at the other end to a revolving plug.

79 *Leary and Callahan* in 1893 secured a patent for a non-leakable pen having a movable nib attached to a spirally coiled spring feed section. The cap containing a swivelling point when placed over the nib point presses the nib and pushes it inside the nozzle of the barrel. Similar methods of receding arrangement have been adopted in the Moore's non-leakable or Waterman's non-leakable fountain pens. (Fig. 155).

80. *J. E. Chase* in 1893 procured a patent by which the nib is, like the above, made to recede when out of use, the nib being permanently attached to a rod by a rivet.

81. *E. Reichmann* in 1893 obtained a patent for a pen in which any form of steel nibs might be used, and having a compressible feed provided with a spring and a long wire ink conductor inside the flexible feed placed under the nib. (Fig. 156).

82. *W. Post* in 1894 took out a patent for a self-filling pen having a piston plunger attached to a rod on the principle of a syringe. The rod might be made of telescopic joints to reduce its length. (Fig. 157).

83. *C. E. Browning* in 1894 got a patent for a pen afterwards known as the "Regal," having a solid prong feed bar provided with side ducts and fitting in the nozzle or point section—the projecting portion of it forming twin-feed grooved tongues between which the nib is held tightly. The top end of the feed-bar is drilled centrally for the inlet of air, and having two side·ducts for the passage of ink leading to an ink chamber in the middle of the feed, formed by a cross drilling, through which the ink finally passes to the nib by means of the grooved passages in the body of the two tongues of the feed. (Fig. 158).

84. *J. H. Stonehouse* in 1894 received a patent for a pen having an ordinary solid grooved prong feed-bar with a central longitudinal groove along its upper surface next the nib and one or more longitudinal grooves on either side for the passage of air. (Fig. 159).

85. *D. Arriaza* in 1894 secured a patent for a pen having a reservoir, the lower end of which is flexible and the top end of which provided with a receptacle for storing solid ink pellets. The ink is freshly made by putting one or more of the ink pellets in the reservoir and adding water. The ink is conducted to the nib by a pressure stud for the finger. (Fig. 160).

86. *F. C. Brown* in 1894 procured a patent for a non-leakable pen in which the nib is placed between the tongues of the feed-bar attached to a rod and passing through a plug at the top end of the barrel. When the pen is out of use the nib is withdrawn inside the nozzle of the barrel by means of a sliding ring attached to the rod. The cap is then screwed on the front end forming an air-tight joint and preventing leakage of ink when carried in the pocket. (Fig. 161).

87. *F. S. Cocker* in 1894 obtained a patent for a fountain pen having a compressible reservoir at the lower end of the barrel to force the ink to the nib point through a feed-bar. A short portion of the flexible tube projects on the underside of the nib, which is being pressed by the finger while writing. When the pen is out of use, the cap on being pushed over the nib section forces a bent spring piece, thus effectually closing the ink outlet. (Fig. 162).

88. *Messrs. Mabie, Todd and Bard* in 1895 patented their famous "Swan" fountain pen which has a long slitted twin-feed rod piece with notches at the end of its bowed tips. The sides of the two strips are grooved, and a bright cylindrical or twisted silver wire feed to regulate the ink flow is placed at one side within the writing section. (Fig. 163).

89. *J. Glass* in 1895 got a patent for a fountain pen having a flexible rubber reservoir attached to a tubular glass ink reservoir. The flexible portion of the reservoir is pressed by the finger through openings in the outer casing to force the ink to the nib point.

90. *W. W. Stewart* in 1895 took out a patent for a complicated pen having a whole length hollow stopper feed-bar slitted longitudinally and containing a

knobbed wire regulator. The stopper feed is fitted into the writing section by its thickened end. The ink is conducted to the nib by a projecting portion of the top-feed bar which also firmly secures the nib in the crescent-shaped groove in which it is inserted. (Fig. 164).

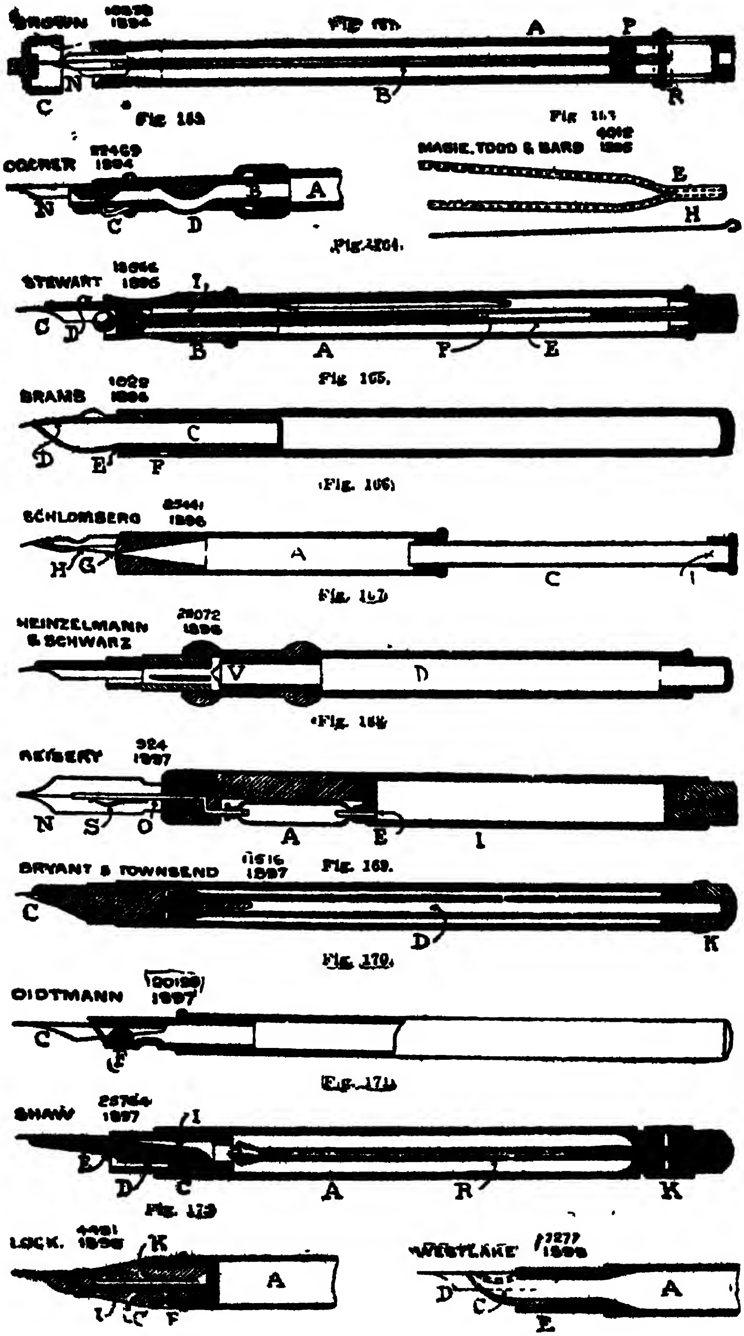
91. *H. Brams* in 1896 received a patent for a pen having a self-filling flexible rubber reservoir or bag placed at the lower end of a metallic barrel. The flexible rubber bag is also covered by a metal plate which is pressed through a side hole in the barrel by means of a blunt point during the act of filling. (Fig. 165).

92. *I. Golwer* in 1896 secured a patent for a pen having a new method to regulate the ink supply to the nib. By depressing a lever controlling a valve at the lower end of the barrel, the valve is raised, allowing the ink to pass to the pen point along the feeder.

93. *C. J. Renz* in 1896 procured a patent for a pen having an air-vent at the top end of the barrel. The ink outlet is guarded by a valve which is opened by pushing back the ink-conducting piece. The ink then flows along a spiral groove, and thence along other groove filling-pockets connected in pairs by holes, and finally reaching to the nib point by the feeder.

94. *W. Schlomberg* in 1896 obtained a patent for a self-filling pen having a hollow tubular plunger piston with a hole at its top to allow the piston to be pushed down the barrel after it is filled. The lower end orifice of the barrel has an ink guide to the nib. (Fig. 166).

95. *Heinzelmann and Schwarz* in 1896 patented a non-leakable pen having a conical valve and two or


BROWN 1894
MAGIE, TODD & BARD 4012 1895
STEWART 1895
Fig. 165.
BRAMS 1029 1896
SCHLOMBERG 1896
HEINZELMANN & SCHWARZ 29072 1896
324 1897
Fig. 169.
BRYANT & TOWNSEND 11516 1897
Fig. 170.
DIDTMANN 1897
SHAW 1897
LOCK. 1898
WESTLAKE 1899

5

more channels for the outlet of ink which may be closed or opened by screwing the barrel end over the writing section. The ink is conducted to the nib by a top-feed prong. (Fig. 167).

96. *E. Reisert* in 1897 got a patent for a pen having a variety of forms of ink-feeding arrangement controlling a compressible reservoir by means of valves The flexible chamber at the end of the barrel being pressed opens a valve under the nib and closes a valve above, thus allowing a supply of ink to the nib. On relieving the pressure of the finger the valve under the nib closes and the valve above opens to admit a fresh supply of ink to this flexible chamber from the barrel. (Fig. 168).

97. *Bryant and Townsend* in 1897 took out a patent for a non-leakable self-filling pen having a glass tubular plunger which can be screwed over the annular passage of the conical valve projecting inside the writing section near the bottom of the barrel, thus making the pen to be carried safely in the pocket after use. (Fig. 169).

98. *W. C. Sherman* in 1897 received a patent for a self-filling piston pen which is operated by a sliding case connected to the piston-rod and screwed into the plug at the top end of the barrel.

99. *A. Oidtmann* in 1897 procured a patent for a pen in which the nib is kept in position inside the nozzle by an elastic ball. When the nib is withdrawn from the nozzle the ink outlet is closed by the elastic ball valve. The nib is not provided with a feed but has grooves in it which conduct the ink to the nib point. (Fig. 170).

100. *Sugden and Wild* in 1897 obtained a patent for a pen having a screwed piston-rod carrying a pin

sliding in a slot. By rotating one part on the plug the piston is moved downward forcing the ink through the feeder to the nib.

101. *W. T. Shaw* in 1897 patented a non-leakable pen having a conical valve piston-rod attached to a screw plug at the top of the barrel as in the "Onoto" pen. The ink is conducted by an under-feed solid prong bar grooved under the nib to allow the passage of ink and having an air-vent drilled crosswise about the middle of the feed bar. (Fig. 171).

102. *G. H. Lock* in 1898 got a patent for a non-leakable pen having a solid under-feed arrangement with two separate ink and air channels both placed under the nib. The ink and air passages are covered inside the barrel by a disk having two holes communicating with them. The writing section can be rotated on the barrel so that the holes may be covered or uncovered as desired. (Fig. 172).

103. *S. N. B. Westlake* in 1898 took out a patent having a curved tubular feed placed under the nib, and also providing the ink reservoir to be closed when not in use by screw plug at one end. (Fig. 173).

104. *Weeks and Morch* in 1898 received a patent for a non-leakable pen in which the writing section can be rotated, like that of Schwarz or G. H. Lock, to admit the supply of ink as desired by raising the piston plug inside the barrel or bringing the valve tight against its seat. The feed also contains projecting wires to regulate the easy flow of ink by their vibration while writing.

105. *O. Winkler* in 1898 obtained a patent in which the barrel is of glass with its end tapered and curved under the nib which is held in a sliding portion of the barrel. The top of the barrel is provided

with a rubber air-ball fitted with a sliding valve which controls the admission of air.

106. *The Eagle Pencil Company* in 1898 designed some forms of feed plugs, one of which consists of a tube slotted along the top to receive a tongue, which separates it into two unequal channels.

107. *J. Blair* in 1898 patented a pen in which powdered ink cartridge is used. The cartridge is carried in a porous bag covered by a sponge. When soft water is poured into the reservoir it dissolves the ink powder.

108. *J. H. Burton* in 1899 got a patent in which there were two ink reservoirs and two writing points. One form has a feed bar having an ink inlet communicating by means of spiral ducts with the ink supply at the upper side, so as to be in contact with the underside of the nib. Another form of feed bar is provided with a screw thread engaging with the point section, and having an elongated ink duct which tapers toward the inner end so that by screwing the piece in or out the ink is regulated.

109. *E. Reisert* in 1899 took out a patent in which the reservoir supplies ink to the nib through a flexible syphon tube provided with a pressing lever which closes and opens the narrow valve passages. Ink enters at the bottom of the barrel and travels up the shorter limb of the syphon and is delivered to the nib at the extremity of the longer limb.

110. *R. Cofani* in 1899 received a patent in which the barrel is of flexible rubber. The nib is carried in the holder provided with a pressure piece. Ink is forced through the barrel by the pressure piece when the nib touches the paper.

111. *F. C. Edgar* in 1899 secured a patent in

which the nib is held by the reservoir above the projected opening of ink outlet from the barrel. An outer casing protects the inner reservoir.

112. *Steinbach and Strache* in 1899 procured a patent in which the writing section is of compressible rubber, tubular and beak-like under the nib, communicating with the reservoir by means of eccentrically placed channels in a plug placed between the barrel and the writing section. The inner surface of the nib when in use is free to move and depress the flexible rubber chamber of the writing section.

113. *S. M. and E. C. Salisbury* in 1900 obtained a patent in which there is a flexible rubber reservoir placed inside a casing made of two sliding joints. The rubber reservoir is attached to a nipple at one end and to a steadying bottom at the top of the barrel casing. The writing section contains a bent wire ink guide under the nib terminating in a flat paddle.

114. *C. J. Holm* in 1900 patented a pen which has a feed plug having a central duct in which is inserted a short tube leading to a rubber tube, fitted with a glass mouthpiece, which delivers the ink to the nib.

115. *W. F. Cushman* in 1900 got a patent for a non-leakable fountain pen exactly similar to that of the Moor's non-leakable pen. The nib is fixed at one end of a hollow spindle, sliding through a plug at the top end of the barrel, and is connected at its other end to a screw-plug provided with a sliding sleeve. The cap is screwed to the writing section when not in use. The nib is withdrawn into the barrel when not in use and pushed forward when writing.

116. *F. E. Clarke* in 1900 took out a patent in which ink is supplied to the nib through a tube which

may be closed or opened by a tapered wire regulator secured to the screw cap.

117. *H. Grass* in 1900 received a patent in which the nib is fixed in slits in the writing section which contains a sponge or wad inside it The top end of the barrel is provided with a screw cap piston valve, which opens and closes while writing or when out of use. In another variety of the pen the reservoir is of flexible rubber encased in a metallic case provided with an opening through which the interior reservoir is pressed during writing. Ink passes from the reservoir through an arrow duct into the under feed of the nib which contains a spiral spring regulating the ink flow.

118. *H. W. Dixon* in 1900 secured a patent in which the ink is sucked into the reservoir by turning the head of the barrel until the inner tube is unscrewed from the plug. The inner tube may then be slowly withdrawn and ink thus sucked upward. When the reservoir is charged sufficiently, further withdrawal of the tube is prevented by wire stops: it is then inverted, and the tube may be moved back into the other extreme position.

119. *F. C. Brown* in 1898 obtained a patent for a non-leakable fountain pen in which the nib is fixed between two tongues of the feed-bar, which terminates in the form of a rod, and attached inside the top end of the barrel to a sleeve nut. A pin in the rod fits in the spiral groove of the nut. When the sleeve is rotated the rod travels in an upward or downward direction, by which process the nib may be drawn within the nozzle and the cap screwed on the writing section.

120. *Messrs. Eyre and Spottiswoode* took out a patent for a fountain pen known as the Caw's safety pen having a tripple feed-bar.

# The History of the Stylographic Pen.

The first stylographic pen using ink was the Egyptian or the Chinese *brush pen*, then the drawing or ruling *bow pen* of the artist, and the next stage of its development was the capillary *glass pipette* and the rigid point *glass pen*. *Marsh's patent* self-filling pen was a tapered wooden nozzle or stylus having a capillary bore and fitted at its top by an India-rubber bulb attached to a handle, and was used as a parcel fountain pen. Messrs. Thacker, Spink & Co., Calcutta, have introduced it again in July 1900 as the new patent parcel fountain pen. *Messrs. Folsch and Howard* in 1809 took out a patent for a stylographic fountain pen made of glass tube tapered at one end to a fine pipette point. *Thomson's* patent in 1849 was a self-filling glass capillary tube fitted with a piston.

The two above sorts of stylo fountain pens were not the modern portable forms of stylo-pens suited to be carried in the pocket. The modern vibrating needle vulcanite stylo-pen is, however, an American invention.

1. *Duncan Mackinnon* in 1875 took out the first American patent for a vulcanite stylo-pen having a whole length and valved drop-needle feed inside the barrel and an air-vent tube passing through the top of the barrel. This was the first original form of stylo-pen, and its great defect was that it leaked in the pocket.

2. *Mr. A. T. Cross* was the first successful pioneer of the modern vibrating needle vulcanite stylo-pen. He patented in 1878 in America a non-leakable stylo-pen for the pocket having a vibrating needle feed and a long vent-tube with air-vent at the top of the barrel

protected by a screw sleeve. The inventor obtained six lacs of rupees per annum by way of 10 per cent. Royalty only. This second form of stylo-pen invented by Mr. A. T. Cross has revolutionized the mode of writing more than the invention of the steel nibs and gold nibs.

3. In 1879 the stylo-pens were introduced into England by *Mr. C. W. Robinson* who first suggested the name "Stylograph."

4. *Messrs. Perry & Co.'s* "Styloidograph" patented in 1879-80 has a valve at the writing section and is merely an imitation of that of Mr. A. T. Cross.

5. *Messrs. Burge, Warren & Ridgley* introduced a stylo-pen on the same principle known as the "British Stylograph."

6. The "*Riverside*" stylo of *Mr. Brown* was also an imitation of Mr. A. T. Cross, but having the needle fixed in the writing section. It was manufactured by the London Pen Company.

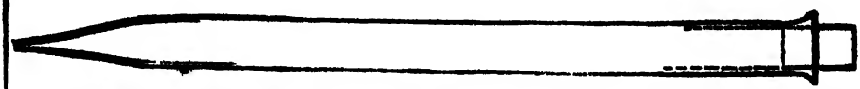
7. The *A. W. Faber's* well-known "Independent" stylo-pen has a fixed needle feed like that of Mr. Brown.

8. The *De La Rue & Co.'s* "Pelican" stylo-pen has a coiled spring needle like that of Mr. W. T. Shaw.

9. The *De La Rue & Co.'s* "Nota Bene" stylo-pen has an air-trap to the air-vent at the top of the barrel, which is intended to prevent leakage.

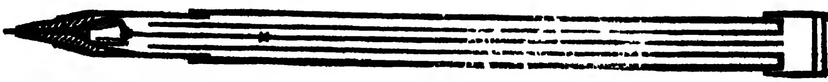
10. *Hansen's* patent in 1880 was the first self-filling stylo-pen on the syringe piston principle.

11. *Sutherland and Brown's* patent in 1880 was the first drop-needle stylo with a long vent-tube, in which the air-vent was placed at the top of the barrel.

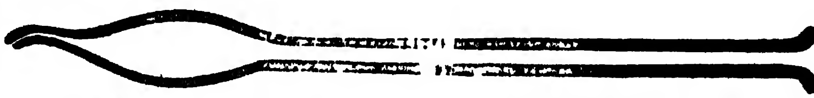


THOMSON 1849

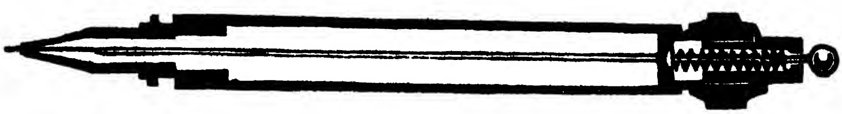
MACKINON 1875



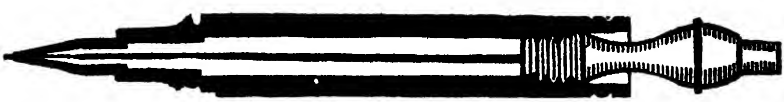
THOMSON 1849



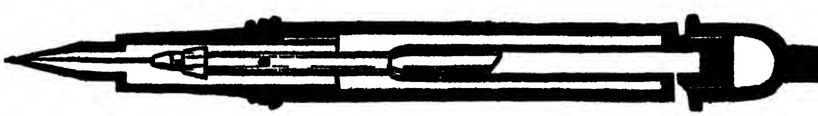
THE WILSON STYLUS 1880.



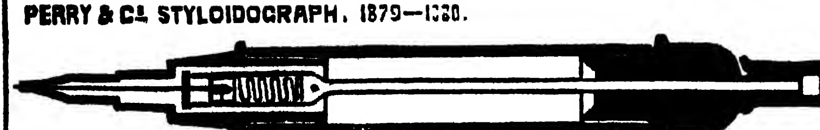
KUTTNERS PATENT 1881.



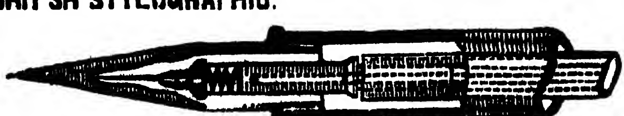
THE CROSS 1878.



PERRY & C^O. STYLOIDOGRAPH. 1879—1880.



THE BRIT SH STYLOGRAPHIC.



12. *N. Wilson* in 1880 took out a patent for a stylo-pen having a whole length wire needle inside the barrel, and a spring valve vent-tube at the top of the barrel.

13. *Mr. C. W. Robinson* in 1880 introduced into England the "Livermore" vulcanite stylo-pen having a very durable writing point made of platinum tube set in gold and the needle feed also of gold, but it was constructed on the American principle of Mr. A. T. Cross.

14. *J. Kuttner's* patent in 1881 consisted of a whole length fixed needle attached to a screw plug placed at the top of the barrel and without any vent-tube, the screw plug admitting air at the top.

15. *J. D. Carter* in 1882 took out a patent for a jewelled writing point in order to make the point very durable.

16. *Mr. M. H. Kerner* in 1882 obtained a patent for a stylo-pen with a rigidly-fixed needle to a long air-vent tube.

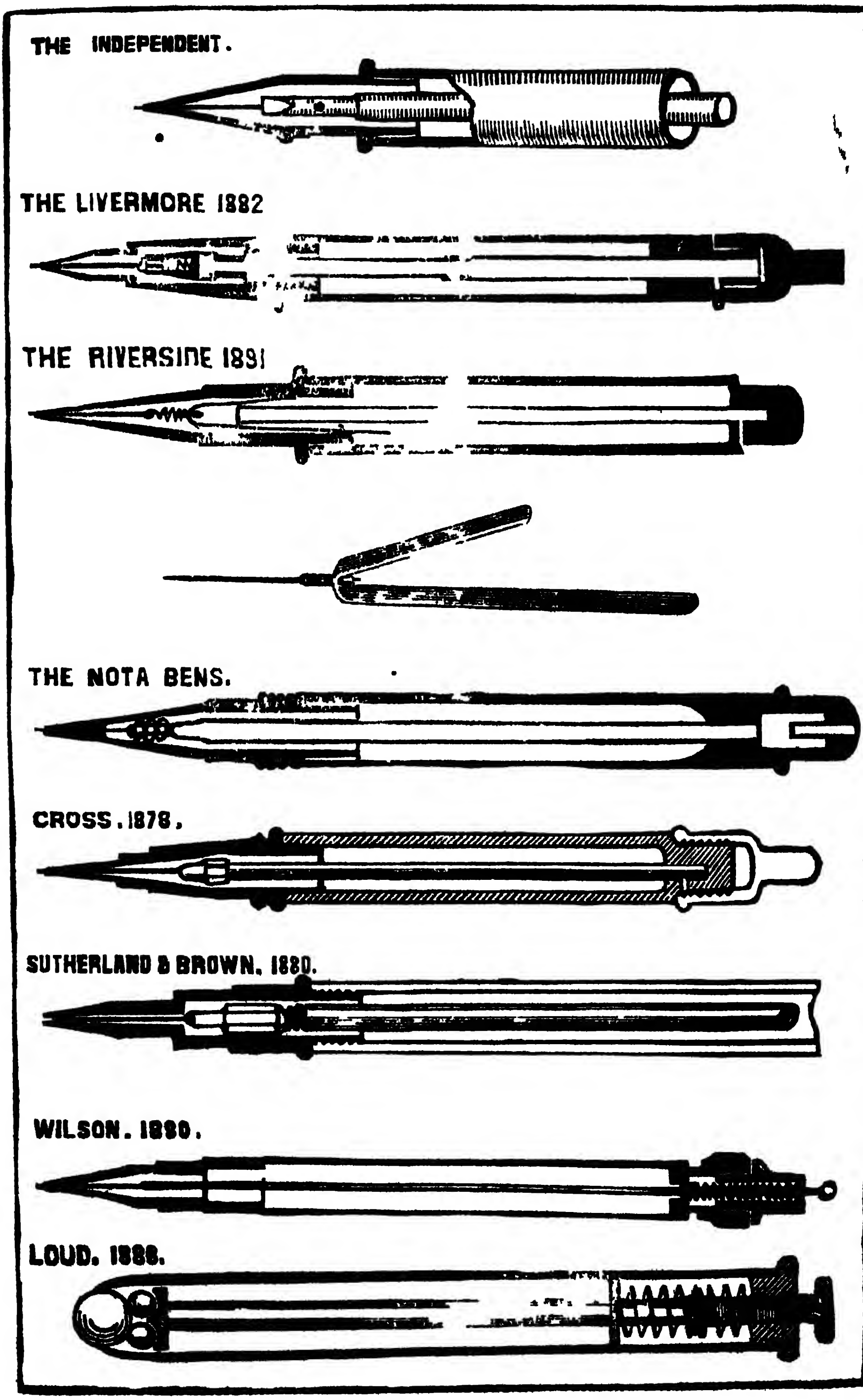
17. *A. W. Faber's* "Independent" stylo-pen is on this principle, and was patented in 1882.

18. *H. Holdsworth* in 1885 introduced a stylo-pen having a gold point tipped with ruby and a gold wire spring needle feed tipped with iridium. The top of the barrel was also made heavier to prevent breakage of the writing point in case of a fall.

19. *W. W. Stewart* in 1888 took out a patent for a stylo having a bristle looped needle to facilitate the flow of ink.

20. *Chambers and Durant* in 1888 took out a patent for a stylo having a reservoir of glass.

21. *J. J. Loud* took out a patent in 1888 for a stylo-pen suitable as a *parcel pen*. The writing point


THE INDEPENDENT.
THE LIVERMORE 1882
THE RIVERSIDE 1881
THE NOTA BENS.
CROSS. 1878.
SUTHERLAND & BROWN. 1880.
WILSON. 1880.
LOUD. 1888.

is a movable spheroidal marking point so as to revolve freely in the point mouth. A screw plug, having an air inlet passing down its centre, is screwed firmly down upon the end of the rod containing the antifriction balls, when the pen is not in use.

22. *Holt's* specification of 1889 consisted of a separate vibrating needle fixed in a hollow spindle inside the writing section and a separate vent-tube at the barrel top. This is also a clever imitation of Mr. A T. Cross.

23. *C. W. Robinson* in 1890 patented a stylo-pen having an elastic needle fixed to a rubber tube.

24. *Wattleworth's* patent in 1891 consisted of a solid writing point made of glass which is corrugated, and the barrel also of glass without any separate air-vent or vent-tube inside the barrel. The corrugated glass writing point admits air from the bottom.

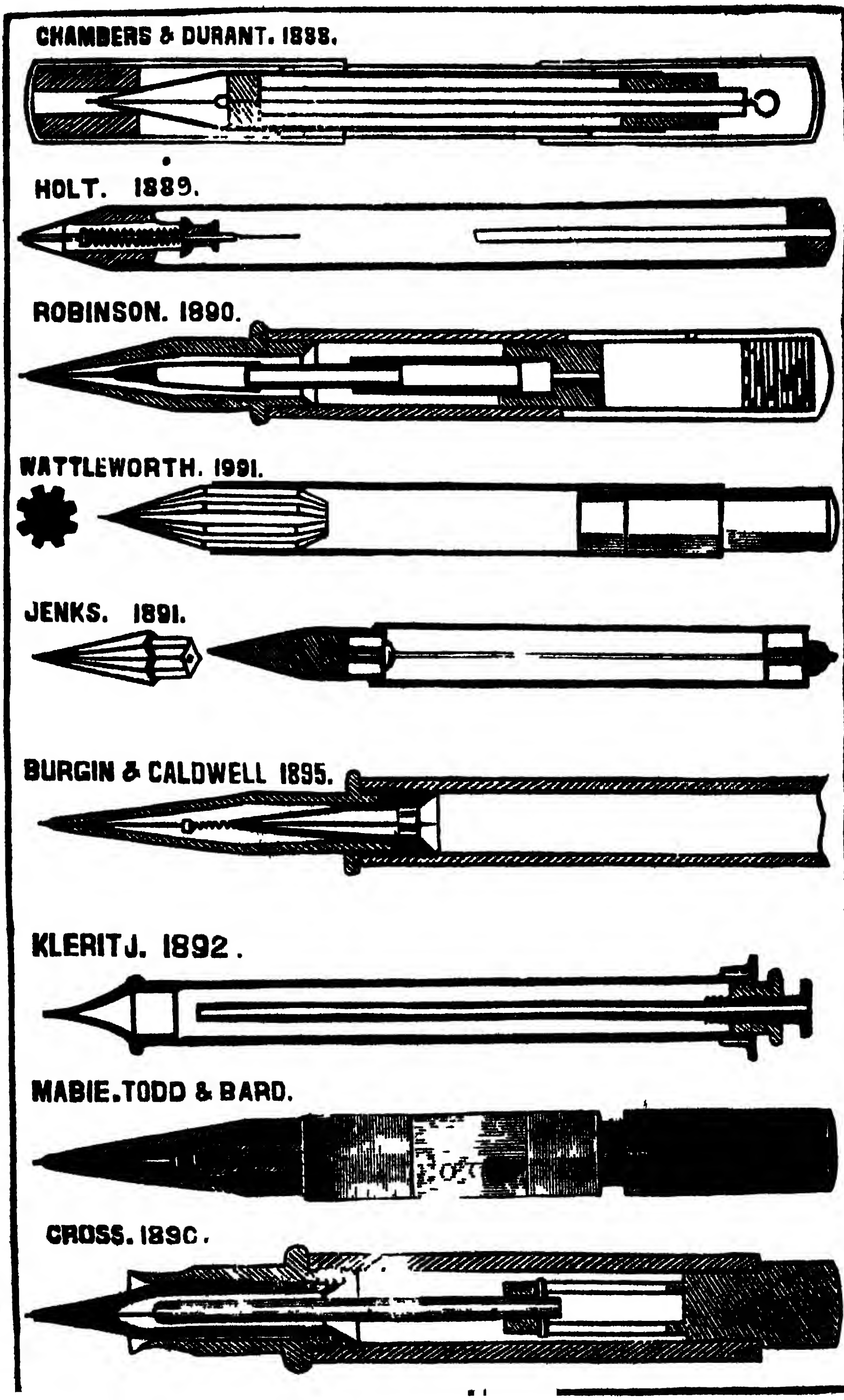
25. *T. Jenks* in 1891 also took out a patent for a stylo having a solid writing point of grooved pyramidal shape and a whole length stylus or needle inside the barrel.

26. *C. P. J. Fitzsimon* in 1891 took out a patent like that of Wilson's stylo, having a whole length needle with two valves instead of one—namely, one at the top of the barrel and the other at the end of the writing section.

27. *G. E. Shand* in 1891 made an improvement for an air-trap intended to prevent leakage of ink along the vent-tube.

28. *E. Lambert* in 1891 took out a patent for a stylo having a rolling writing point similar to that of *J. J. Loud's* patent of 1888.

29. *L. Kleritz* in 1892 obtained a patent for a stylo-pen suitable for *manifold writing*. It relates to


CHAMBERS & DURANT. 1888.
HOLT. 1889.
ROBINSON. 1890.
WATTLEWORTH. 1991.
JENKS. 1891.
BURGIN & CALDWELL 1895.
KLERITJ. 1892.
MABIE.TODD & BARD.
CROSS. 1890.

a stylo-pen in which the writing point is of steel cone with a capillary bore and the barrel having a regulating vent tube at its top end. Several patents were taken out for similar instruments.

30. *Burgin and Caldwall* in 1895 took out a patent for a stylo-pen with a valve spring needle placed inside the writing section, but having no air tube inside the barrel.

31. *Messrs. Mabie, Todd and Bard* introduced the "Cygnet" stylo similar to that of A. T. Cross.

32. *A. T. Cross* again in 1896 took out a patent for a stylo-pen having a single air-vent passing through the writing point and a sliding drop needle inside the barrel. This pen was afterwards imitated by the "Gravity" stylo-pen maker of America in 1902.

33. *A. Dittmar* in 1896 took out a patent for a stylo-pen having a fine pointed capillary tube bent like a syphon and dipped into an ink reservoir.

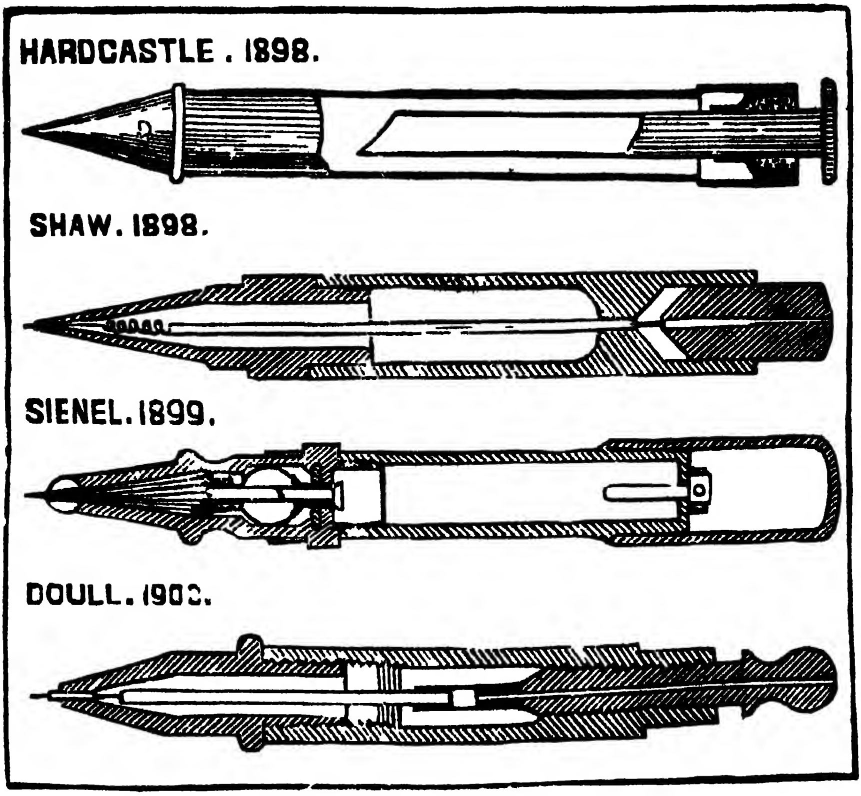
34. *J. Hardcastle* in 1898 took out a patent for a self-filling stylo-pen having a hollow tubular plunger piston sliding through a rubber washer, and a single air-vent placed in the writing section but with no needle inside, similar to that of the A. T. Cross pen of 1896. This was a complicated stylo without a needle feed.

35. *W. T. Shaw* in 1898 took out a patent for a stylo-pen having a coiled spring needle feed similar to that of A. T. Cross, but possessing a separate clearing needle placed at the top of the barrel.

36. *H. Sienel* in 1899 took out a patent for a most complicated stylo-pen having no vent-tube but a small valve tube at the top of the barrel and a needle fixed to a rubber bulb fluted cone placed inside the writing section.

37. *Doull and Doull* in 1900 took out a patent for a stylo-pen having a needle fixed to a rubber tube placed at the top of the barrel like that of Mr. C. W. Robinson's patent of 1890.

38. The "*Gravity*" stylo-pen was patented in America in 1902. It has a drop needle placed inside




the writing section and a single air-vent placed inside an annular groove of the writing section.

39. The "*Onostyle*" self filling stylo-pen patented by Messrs. De La Rue & Co. of America is a self-filling stylo, similar to a gravity stylo, in which there is a piston plug with double air-vents on oppositely

placed notches in the writing section and a spring needle fixed inside the same. (1909).

40. An *Electric* stylo-pen which renders forgery impossible and writes with 10,000 volts of electric current sparks by marking the paper with burning perforations has been invented by Dr. Dinshah P. Ghadiali, the Parsee Electrician, in 1909. This pen is only suitable for the desk and cannot be used as a portable pen for the pocket.

41. The *electric stylo-pen of Edison* patented in 1877 was in general use for many years for making manifold copies of manuscript. The stylus of the pen produced punctures on the paper and was used as a stencil to make any number of copies (when manifold carbon paper and the type-writer did not come into existence).

## The Manufacture of Stylo and Fountain Pens in India.

### The History of Dr. R. N. Saha's "Wireless Stylo-Pen."

The greatest blessing which India possesses under the British Rule is Peace and Order which are the prime conditions for the material progress of a country, as they give free scope for individual effort and large opportunities for individual talent in spite of class or caste exclusiveness, for industry and its principle of accumulation would be paralysed without the sense of security of person and of property.

The Indian Copyright Act was passed in 1847, and

the Press and Registration of Books Act followed in 1867. The Letters Patent for the promotion and protection of invention began in India in 1856, but the volume of patents did not swell before Act XII of 1888. India must contribute her share in the world's works, and she has had to win her prizes in the industrial world. She did not, therefore, escape the infection of invention and the catalytic action of the light of Western science. Dr. J. C. Bose is her Franklin; Dr. P. C. Roy is her Dalton. With the spread of education the civilization of the world has but just dawned and all men of all races, all tongues and all colours, will in turn take up their share of progress in industrial science. The world is full of workers as in a bee-hive, and in every hive of industry in every corner of the globe are geniuses working for the sake of work itself.

Mere accident, chance observation or "opportunities" will not produce an invention. Without keenness of observation and the power of utilizing it such accidents are of no moment. The so-called accidents or opportunities, big or small, must be carefully improved by genius. Ignorance cannot be a qualification or passport for discovery, invention or science. If Galileo discovered the secret of the pendulum from the swinging to and fro of a hanging lamp, Newton discovered the laws of gravitation from the fall of an apple to the ground, Galvani discovered the electric battery from the twitching of a dead frog's legs in contact with a metal, Dr. Laennec invented the stethoscope almost by an accidental discovery of the process of auscultation (1819), Dr. Jenner discovered vaccination from the story of cowpox from a Welsh girl, James Paget as

medical student discovered in 1833 the Trichina Spiralis, Dr. Ronald Ross discovered the etiology of malaria from the story of its production from mosquitoes, Humphrey Potter—the lazy, playful boy—discovered the origin of the modern automatic valve gear for steam engines, Gramme's assistant in 1873 discovered the electric motor by accidentally connecting two Dynamos, one of which was working; and Archimedes discovered the specific gravity from the displacement of water from his water-tub during bathing—it is because they all noticed them in the way they deserved and profited thereby by their golden discoveries and inventions.

Many things pass before our eyes unnoticed, but when they are observed with proper attention, new things, new charms delight the observer, simply because he has an eye to watch them and to use the new facts derived therefrom to bridge a gap either in art or in science. While yet a senior medical student of the Calcutta Medical College studying Hygiene, young R. N. Saha was struck with the discoveries and radical inventions of great medical men. He observed that Dr. Richard's horse-less vehicle in 1690 was the forerunner of the modern bicycle; Dr. Barker gave to the world the Water Turbine Mill; Dr. Denis Papin discovered the compressed air motor in 1695; Dr. Jenner discovered in 1795 the great blessings of vaccination while a medical student; Dr. Lafargue discovered the hypodermic medication, 1838; Dr. Lister discovered antiseptic surgery, 1865; and Dr. Field improved the syphon in his "intermittent" flush tank by means of his annular syphon. When he observed that even such a simple mechanism as the syphon could be further improved, suddenly the word

" intermittent " led him to think over some improvement of A. W. Faber's stylo-pen which he was in the habit of using in taking down lecture notes, and which frequently choked the flow of ink. He then experimented till he succeeded in getting over the difficulty by making a wireless stylo-pen on the " intermittent " fountain principle, and afterwards obtained the following patents :—

1. The first patent for a stylo-pen in India was awarded to Dr. R. N. Saha of Chinsurah, District Hooghly, in Bengal, in the year 1900. (Indian Patent No. 187.)

This is the first attempt for a wireless stylo-pen, doing away with the complex vibrating needle, on the intermittent fountain principle or that of a syphon inkstand. In this there was a single air-vent at the top of the writing section and a small vent-tube inside it. The " wireless " stylo-pen, not unlike the wireless message, is a new force in the writing world and destined to be one of the greatest conveniences ever invented for the writer.

2. In 1901 he obtained the first English patent in Great Britain for his wireless stylo-pen, and the Patent No. 18583 was granted on the 17th September 1902. This relates to fountain or stylographic pens in which the flow of ink from the reservoir to the writing point is intermittent. The writing section has a single air-vent and a small vent-tube with two other orifices connecting it with the barrel.

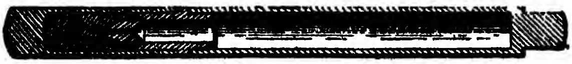
3. The first German patent applied for in 1900 was finally granted to him in 1902 after much opposition.

4. The next improvement in the wireless stylo-pen on the syphon inkstand principle was secured

by him under Indian Patent No. 394 of 1907. In this pen there are two air-vents protected under an annular groove very near the point of the writing section. It is very simple and absolutely free from complex mechanism. There is nothing to get out of order by constant use. No other stylo-pen can imitate such easy writing qualities and allow such maximum comfort at the desk.

5. The first patent for a wireless stylo-pen was taken in America by Dr. R. N. Saha in his Patent No. 962982, dated 28th June 1910. In reviewing this patent the 'Scientific American' of September 3, 1910, wrote as under :—

"An important feature of the invention consists in the provision of two air-vents situated within the



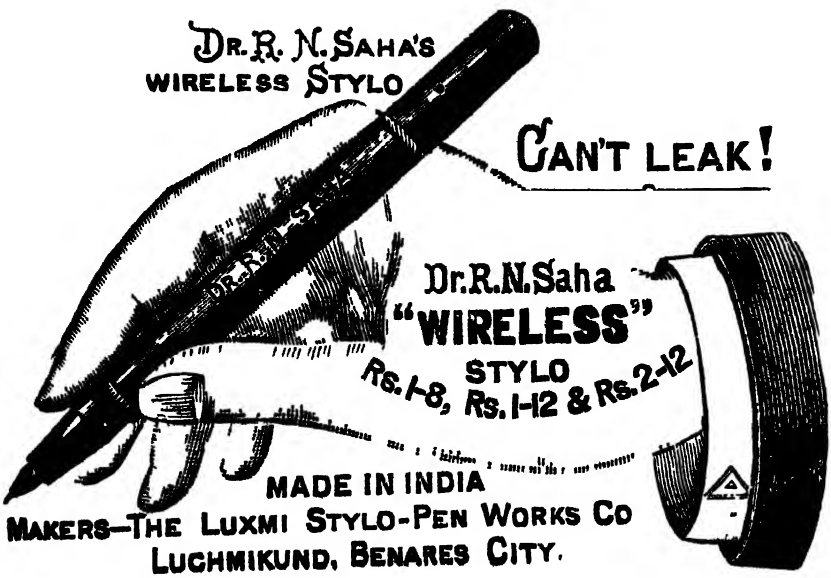
annular groove at the end of the writing section as shown in the fig. By this means the long air-tube with the delicate fixed or drop-needle feed of the common stylographic pen is avoided. The air-vents permit the ink to flow smoothly to the last drop. The pen is especially adapted for making good carbon copies."

6. The latest improvement in wireless stylo-pen is the simplest self-filling mechanism invented by him which is applicable both to his stylo and fountain pens.

7. The last improvement in fountain pens is the calendar stylo and fountain pens patented in India in 1904. (Indian Patent No. 200.)

## The Luxmy Stylo-Pen Works, Benares.

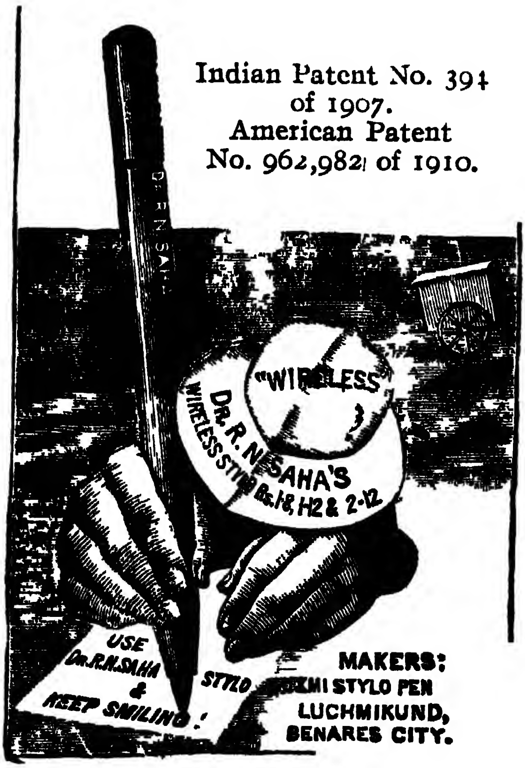
The inventor, Dr. R. N. Saha, in spite of various difficulties in making automatic machineries (for the manufacture is still a secret), and despite the handicap of the five per cent. custom duty and heavy local octroi on imported rubber, succeeded after seven years of toil and trouble to found the "*Luxmy Stylo-*




*Pen Works*" in Benares in the year 1907. This pen factory of Benares is the first and only engine-turned Stylo and Fountain Factory in India. It manufactures pens surpassed by *no* other pen in qua'ity and durability, and their price is much cheaper than that of any imported pens in spite of the recent rubber "boom" which has raised the price of raw rubber from 3s. to 12.5s. per lb.

The opening ceremony of this factory was thus described in a leading Calcutta Daily:—

"*Mr. E. H. Radice, C.I.E.*, the Collector-Magistrate of Benares, was invited at the "Luxmy Stylo-Pen Works," together with many leading residents, both




*"Wireless" Stylo-pen is the only pen suited for making good carbon copies.*

European and Indian, of the station. The inventor Dr. R. N. Saha is a young man of inventive turn of mind and of a scientific taste. He is the son of the great linguist, author and distinguished retired Civil

The four figures of this illustration represent *Capital* in Dr. B. N. SAHA, Rai Saheb ; expert Knowledge or *Brain* in Dr. R. N. SAHA, the inventor ; security to trade or real "*Protection*" in the Magistrate ; and efficient *Labour* in the Mechanic of the Factory.

Dr. R. N. Saha
(Inventor and Founder).

A. Goffur
(Head Mechanic).

Dr. B. N. Saha,
Rai Saheb
(The great Linguist & Retired Civil Surgeon).

E. H. Radice, C.I.E.
(Collector-Magistrate, Benares).

The Luxmi Stylo-Pen Works, Benares.

Surgeon of Bengal—Rai Saheb Dr. Brojo Nath Saha. The stylo and fountain pens are manufactured in his own workshop by power. Mr. Radice recorded—'I had no idea anything so good and complete in a small way existed in Benares. All the work from the rough materials is made on the spot, and even one of the lathes and majority of the tools have been made here.' At the end of the ceremony Mr. Radice was garlanded and photographed."

### How the Factory Originated.

The first model of a stylo-pen cost the inventor the exorbitant sum of Rs. 500, which was extorted under various pretexts by one Nilmony Karmakar, a mechanic of Chandernagore, who took about a year to complete a satisfactory model in vulcanite. On examining this model Mr. Brühl, Professor, C.E. College, Sibpur, strongly advised the inventor to go to America, where he was sure to make a fortune, for he said: "India cannot at present manufacture this"; notwithstanding, the inventor thought it advisable to start the factory in India.

Financial difficulty having arisen to meet the continual costs of patents, patent taxes, and manufacture of various models, amounting to over Rs. 3,000, the inventor's friend, Dr. Dasarathy Dutt, M.C.P.S., Assistant Surgeon, secured for him the post of an Assistant Surgeon to meet this crisis; nevertheless, he preferred to set up private practice at Benares, with a view to devote himself freely to his favorite scientific hobby, and eventually, after four years of medical practice, determined and succeeded in establishing a Stylo-Pen Factory at Benares, not accepting even the

kind offer of a lucrative appointment from the Raja of Daltongunj. It was at this time the late Maharajah of Tipperah also became his patron, and promised a substantial help, but as the Maharajah was cut short by a motor accident at Benares, his Highness' promise to the inventor was not redeemed.

The first factory hands, recruited from the Lucknow Railway Workshops, after a year's training and work by treadle power, demanded higher wages when the factory was equipped with engine power, struck work, and were dismissed. It became, therefore, necessary for the inventor to train up a composite force of Hindu and Mahomedan workmen in carpentry, smithy, turning and casting of metals, so as to avoid the possibility of future strikes. The nephews of the inventor, Babus B. N. Sadhu, S. M. Dutt, and B. B. Dutt, and his sons-in-law, Babu Robindra Mohan Dutt, son of Rai Sashy Bhuson Dutt Bahadur of Santipur, and Babu Sukendra Nath Das, son of Babu Jodu Nath Das, the distinguished merchant of Krishnagor, all take active interest in the factory works, and most of them can turn and fit up a complete Fountain-pen. The Factory need not, therefore, be closed up, for in the event of a future strike a new set of hands might easily be trained up within a very short time. Each factory hand can now turn out three to six dozen finished Fountain-pens, in a day of eight hours, under the able management of the inventor's nephew, Babu Bhupendra Nath Sadhu. Recently a branch of the Luxmy Stylo-Pen Works Co., at 77/2, Harrison Road, Calcutta, has been opened under the able management of Babu Woopendra Nath Saha, Government pensioner.

The exterior of the Buildings of the Luxmi Stylo-Pen Works,
16 & 17, Luchmikunda. Benares City.

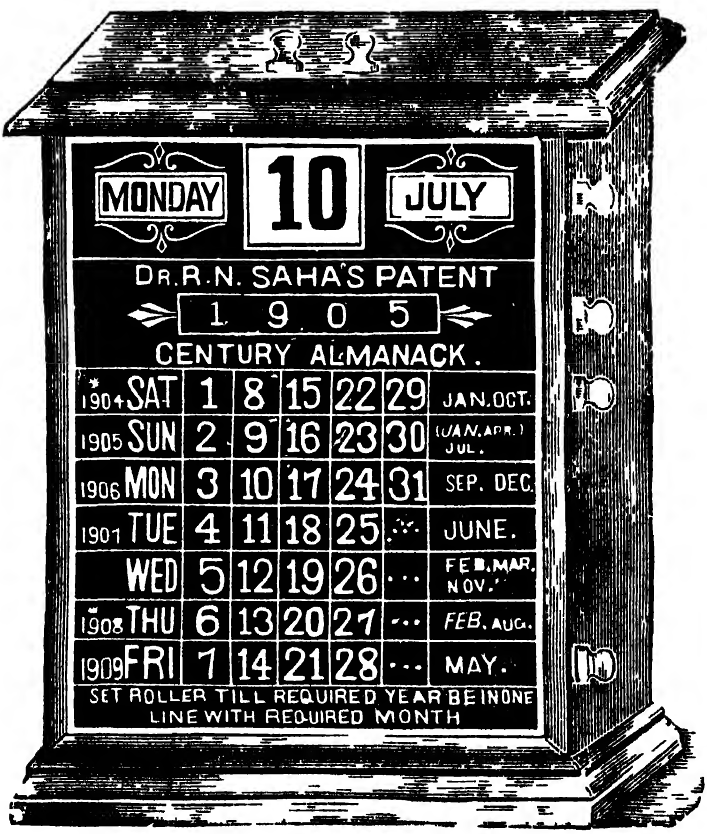
## The Manufacture of Calendar Stylo-Pens in India.

In England the old style of calendar ended on September 2nd of 1752 A D., and the new style of Calendar Reformation with the leap year commenced on the following day—that day being called September 14th, 1752. Thus in that year the dates from September 3rd to 13th did not exist. Dr. R. N. Saha fortunately for the first time observed that owing to the introduction of leap years in every 4th or century year, a calendar year repeats like a recurring decimal every 5th, 6th or 11th year. Like most other important inventions the evolution of the present perennial calendar did not spring into existence by a mere coincidence of so-called accidental discovery. We have various forms of beautiful annual or permanent calendars thrown at us from every side, thanks to the rage of advertisement. With the ever-increasing tide of progress and material advance of the age, the American stem-winding watches and the type-writer took the sleeping nineteenth century man by surprise, and in the twentieth century Dr R. N. Saha's automatic frame calendar and stylo-pen have become a necessary factor in the modern business correspondence and like his wireless stylo-pen and tubular feed fountain pen are invaluable to all offices and professional men.

The history of the art shows how step by step various forms of frame calendars, cabinet calendars, calendar clocks and watches, calendar blotters, calendar lockets and pencils came into existence. We have the *Somerville* Daily Date Indicator combined with the monthly Date Indicator and the *Hanover* Per-

petual Date Indicator in the market. We see various forms of calculating charts for ascertaining dates from 1752 to 1952 We have the calculating table of the so-called perpetual calendar by *H. F L. Meyer.*

Within the last forty years inventors, one after the




other, followed the craze of inventing the so-called perpetual calendar, not unlike the Alchemist's attempt to find out the Philosopher's Stone or the Machinist's three-hundred years' hunt after a "perpetuum mobile." This is shown by more than half a dozen

patents in America, viz., *Pooler* 1868, *Clark* 1872, *Talcott* 1886, *Hamilton* 1889, *Drefus* 1893, *Milne* 1898, *Zachrisson* 1900, and the ten years' calendar of the *Whitehead & Hoag Co.*, 1904, in all of which there are more or less confusion, loss of time and labour and some need of calculation, key reference or substitution and liability to errors. Thus it is not a little credit to an Indian for having perfected a foreign invention.

Dr. R. N. Saha's automatic calendar is quick and easy to operate, can be read at a glance from a distance, and no separate almanac is required to set it. The young doctor was awarded a gold medal and a prize of Rs. 1,200 by Rajah Chandra Chur Singh of Oudh for this useful invention.

## The Choice of a Cheap Motive Power for the Manufacture of Fountain Pens.

*Various motive powers.*—With the introduction of steam engine, the era of manual labour has been supplanted by the era of mechanical labour about the year 1796 in Europe. Before that period animal strength of man and beast or the natural powers of the flowing water and wind, where available, were utilized. In India even to-day we see the primitive bullock power oil mill (*ghany*), the man power husking mill (*dhenky*), the man power or the water power —flour grinding mill (*panchakky*). In these days of inventing new ways of buying cheaply and new ways of underselling or attracting the customer the man who ignores all new methods and sticks doggedly to the old-fashioned methods will find himself outstripped in the race of life and industry. To-day the

solid, liquid and gas fuel in the shape of coal, oil, gasoline or alcohol, and gas are all used for the generation of power, and even electricity has been harnessed for the transmission of power by natural waterfalls. In Holland the wind mills furnish a great source of power of which there are more than ten thousand.

*Motive powers* :—

Physical
1. Steam Engine (James Watt 1790).
2. Steam Turbine (De Laval 1883, Parson 1884 and Curtis).
3. Hot-air Engine (Erickson).
4. Compressed-air Engine.

Chemical
5. Oil Engine (Kerosine).
6. Gas Engine and Gasoline Engine (Motor Car and Aeroplane Engine).
7. Alcohol Engine.

8. Hydro-electric Motor :—(from Dynamo worked by water power).
9. Water Turbine.
10. Tidal and Wave Motors.
11. Wind Mill.
12. Sun Motors.

*The Steam Engine :—History of its development.*—The first mention of the steam engine is that of *Hero* of Alexandria about 130 B.C. *Geovanni Branca*, the Italian, made the steam wheel in the seventeenth century; but the air-pump of *Von Guericke* invented in 1615 was the direct ancestor of the steam engine. In 1680 *Huyghens* invented a gun-powder engine. In 1690 the French *Doctor Denis Papin* invented an improvement of the Huyghen's engine by substituting

steam instead of gun-powder. *Marquis of Worcester* and *Thomas Savery's* steam suction and force pump as well as *Newcomen's* engine invented about 1698 were all atmospheric engines using steam.

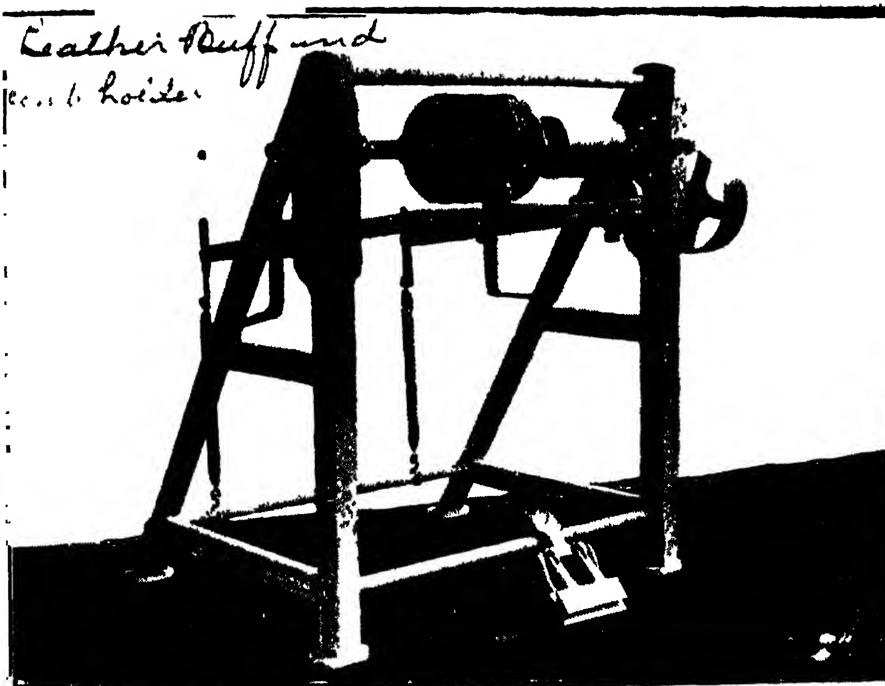
*Mr. James Watt* invented an improvement of the Newcomen's engine. This was a real steam engine using, for the first time, the steam for the direct generation of power in the year 1790.

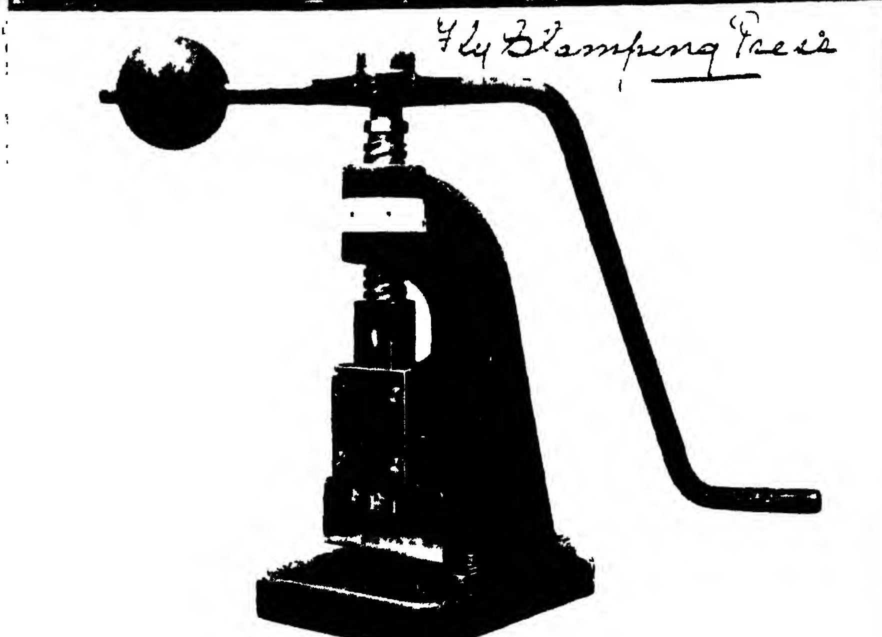
The first true *internal combustion engine* is to be seen in the gun-powder engine by means of the cannon and gun-powder, whose use was known in prehistoric India and China. The use of gun-powder was afterwards introduced by the Saracens into Europe, and cannon is first mentioned as being used at the Battle of Crecy in 1346. In 1678 *D'Hautefeuille* in France first used gas as a motive power. In 1680 *Huyghens* attempted to use gun-powder for obtaining motive power. The French *Dr. Denis Papin* in 1690 made use of Huyghen's experiment of the vacuum method by substituting steam for gun-powder. So fierce was the opposition at the time that the watermen of Zeune in 1707 destroyed Papin's steam-boat and he narrowly escaped being killed. The first real gas engine was made in 1791 by *Mr. John Barker*, and it was improved by *Mr. Street* in 1794, who used the vapour of the oil of turpentine. *Mr. Brown* in 1823 tried to utilize Huyghen's vacuum method by using ordinary fuel instead of gun-powder, to expand the air. *Mr. Wright* in 1833 made a really good gas engine and *Barnett* in 1839 improved Mr. Wright's design. Up to 1850 there were two other workers, namely, *Bansanti* and *Matteucci*. It was *Lenoir* of France that made in 1861 the first commercially practicable gas engine. In 1862 there were

three-hundred gas engines used in France. Then followed the improvements of *Siemens*, *Beaude*, *Rocchas* (Fr.), *Otto Simon* (Gr.), *Dugald Clerk*, '*Priestman*, *Daimler*, *Dowson*, *Mond*, *Diesel* and others who have helped to bring it to its present state of perfection.

To-day steam is being dethroned by the gas engine as motive power in land, air and water. The *advantages of the oil engine over a steam engine* are (1) the oil engine is self-contained for its supply of fuel, (2) it requires less attention than a plant equipped with steam engine and boiler, (3) there is no fear of explosion as with a steam engine, (4) there is no fear of destruction by fire, (5) no hauling of fuel is required, nor is there with an oil-engine any consumption of water, if storage tanks are installed; (6) an oil engine does not deteriorate, if left standing idle; (7) and lastly it requires no skilled attendant.

The internal combustion engine uses a liquid or a gaseous fuel instead of solid coal, such as kerosine oil, gasoline and alcohol or gas from a blast furnace. In the United States of America there are to-day four lacs of gasoline engines in use, and over one-and-a-half lacs of gasoline engines made annually in America. The waste gases issuing from the blast furnaces are turned into profitable use by the gas engine. More than 500,000 H.P. is being developed in Germany alone by the gas engines using the valuable waste by-product gases of the iron industry. America has followed the suit of Germany. Germany also has more than six thousand alcohol engines using duty-free alcohol. France and the United States have followed the example of Germany in using alcohol engines by removing the excise tax on industrial alcohol.




1. Leather Buff Polishing Machine.
2. Name Stamping Fly Press.

Thus we see the mechanical trigger of the bow gave place, to the chemical trigger of the gun, and the destructive chemical trigger of the gun-powder has now become after two thousand years the peaceful motor in the 'Battle of Business' of the modern factory, bringing cheap power within the reach of all and enabling the workmen of to-day to be their own masters in their small workshops.

*The kerosine-oil engine* dates from 1870, and is now largely used by small capitalists.

The following classes of engines are in use :—

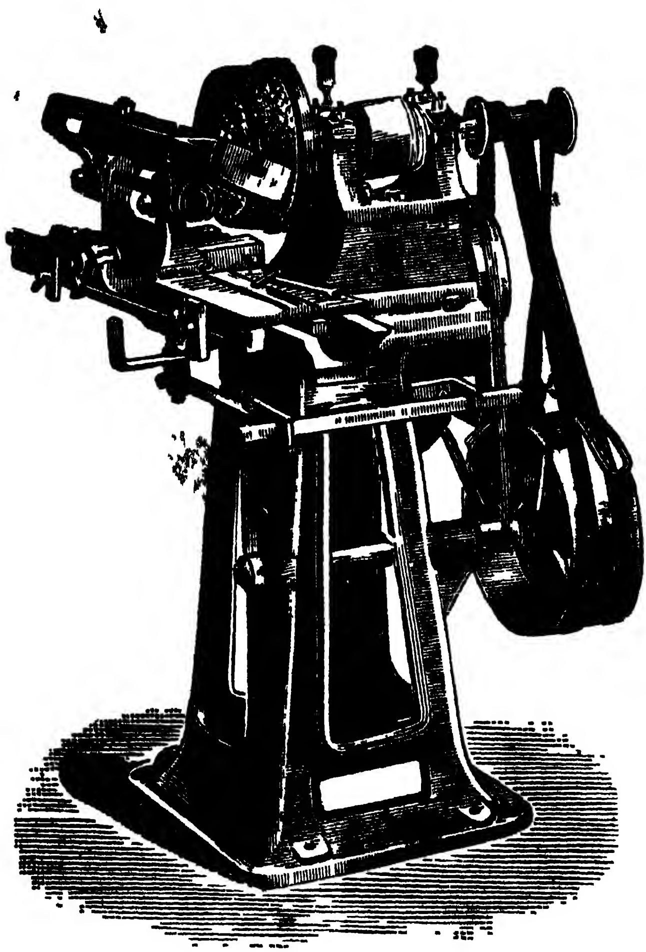
1. Hornsby-Akroyd Oil Engine.
2. Crossley Type.
3. The Campbell Type.
4. The Priestman Type.
5. The Cundal Oil Engine.
6. The Mietz and Weiss Engine.
7. The Barker Engine.
8. Diesel Oil Engine.

In sizes of 75 horse-power and upwards the Diesel oil engine is the best oil engine and the most efficient heat motor ever invented. The cheap mechanical power of to-day has, by removing the old world bondage of mere brute work, converted man "the human machine" into an intelligent brain-worker in the factory lives of the globe.

## Machinery for the Manufacture of Stylo and Fountain Pens.

The modern automatic screw-cutting treadle or power lathe, polishing lathe, stamping machine,

engraving machine, wire-drawing machine, ruby draw plates, sheet roller machine, the various nib-making



*Vulcanite polishing machine.*

machines already mentioned, emery grinding machine, and automatic boring machines and accessories are required for the manufacture of fountain pens.

The Workshop.

A Part of the Machine Room of
The Luxmi Stylo-Pen Factory at Benares.

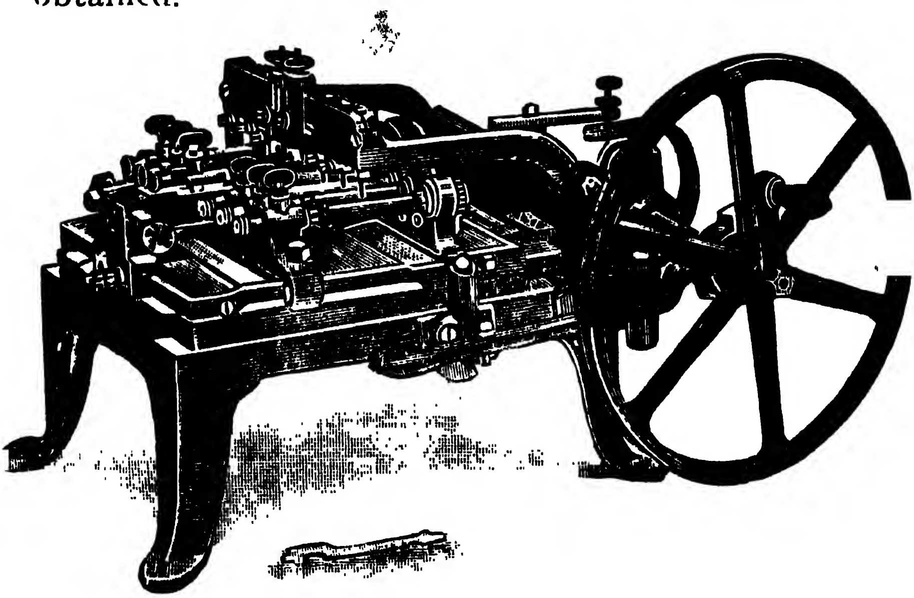
## The Fountain Pen Making Plant.

It consists mostly of the following:—

1. Special automatic screw-cutting lathe with various chucks and attachments.
2. Special automatic polishing lathe.
3. Fly stamping press for stamping fountain pen barrels with name dies and heater.
4. Heating table for softening ebonite.
5. Steam heater for softening ebonite.
6. Set standards and grindstones.
7. Leather buff machine for polishing pens with set of standards, coat necks buff and cotton buffs.
8. Copper wheel machine and standards for sharpening cutters.
9. Grailing machine for rounding corners and tapers.
10. Automatic barrel engraving machine, and various knurling tools for chasing by the hand.
11. Sheet roller machine.
12. Ruby draw plates and tongs and draw benches, the hammer and the anvil.
13. The various fly presses and nib-making machines already mentioned.
14. Emery grinding machine, and automatic drilling machine and accessories.
15. Special chasing tools and cutters.

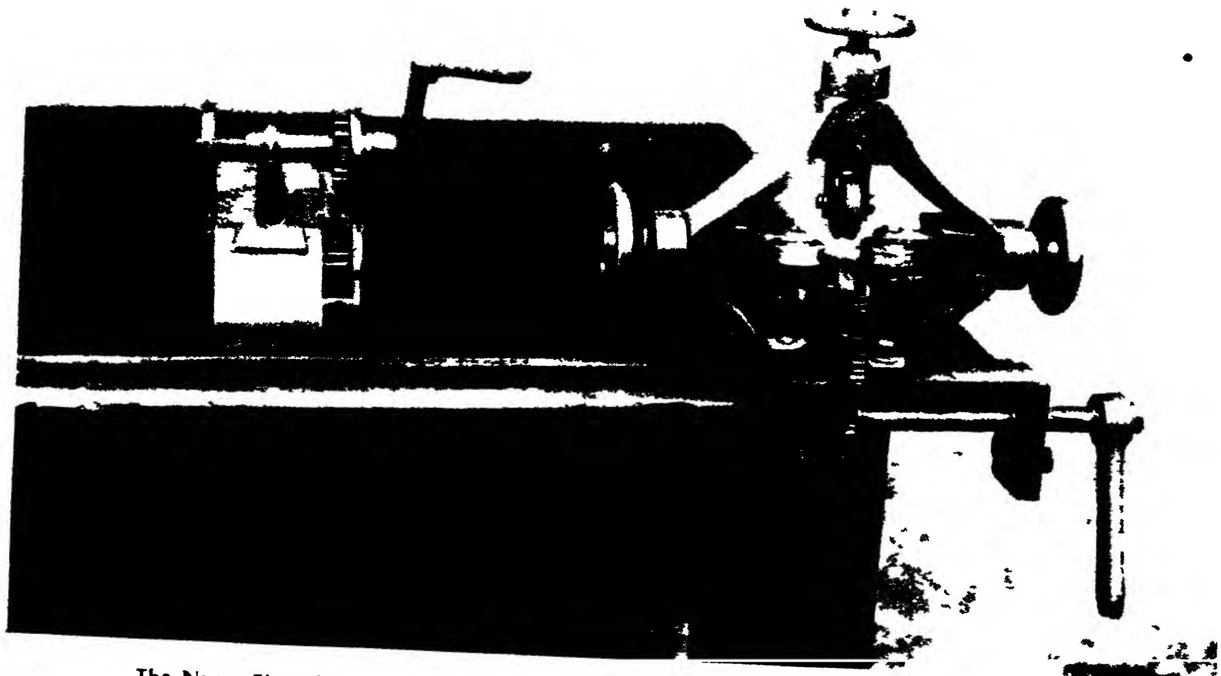
*The Lathe: its history and development.*—The potter's wheel which has been used from time immemorial in India and older than the Pyramids of Egypt, as also the Indian pole-lathe ascribed by some to the ancient Greeks about B.C. 1240, were the forerunners

of the modern lathe. The potter's wheel worked on clay and the Indian pole-lathe with its fixed tool rest was solely used for wood-work. The accuracy of the work depended on the steadiness of the human muscles. The modern compound slide rest of the lathe was invented by *Bentham* in 1793 by means of which mathematical accuracy could be mechanically obtained.



*Automatic Engraving Machine for Fountain Pen Barrels.*

*Joseph Bramah*, the famous inventor of the hydraulic press, also patented a slide rest in 1794. *Henry Maudsley* perfected the lathe, and the slide rest was finally adapted for screw-cutting and metal chasing, which thus revolutionized the mechanical art by producing true surfaces in the lathe. How the older order changeth! The Indian potter's lathe and the pole-lathe, after myriads of cycles of events, have evolved into the modern automatic screw-cutting lathe.



The Name Stamping Press. The Fountain Pen Engraving Machine.

Both these machines are inventions of Dr. R. N. Saha, and are used at the Luxmi Stylo-Pen Factory at Benares.

## Raw Materials used in the Manufacture of Stylo and Fountain Pens—their History.

*Raw materials.*—Both soft vulcanized India-rubber and hard India-rubber or vulcanite or ebonite are used in the manufacture of stylo and fountain pens.

*The India-rubber.*—The India-rubber or caoutchouc is the dried gum of the rubber tree *Jatropa Elastica* of Brazil in South America, and the *Ficus Elastica* of Assam in India. The rubber tree grows wild chiefly in South America, Central America, Mexico, Africa and India. The Para rubber of Brazil is egarded as the best quality of rubber. The substance was known to the natives of Peru and Hayti from time immemorial whe.e the inhabitants used to play a game with the India-ıubber balls. It was also known to the aboriginal Lushai and other hill tribes of the North-Eastern Hill Tracts of India where they used to make round rubber balls. After the discovery of America by Columbus in 1492, it was first mentioned by *Herrera* in the second voyage of Columbus. The French Chemist and Explorer, *M De La Condamine*, in 173ᵉ first introduced India-rubber into Europe. *M. F' ..an* in 1751 and *M. Aublet* in 1755 afterwards experimented with it. *Dr. Pricstly*, the English Chemist, in 1736, suggested the use of India-rubber for rubbing out pencil marks, and up to 1820 India-rubber, as its name implies, was used only for effacing pencil marks from paper. It was sold at that time for Rs. 2 for a piece half-an-inch square. From this time it became an article of commerce. The vulcanized rubber is an exclusive industry of the nineteenth century, and its industry and applications are legion. To *Charles Goodyear*, the American, belongs the honour

of the discovery of the process of vulcanizing rubber in the year 1839. *Mr. Thomas Hancock* in England accidentally rediscovered this process in 1844; while examining a rubber shoe imported from America he found that there were sulphur particles deposited on its sole, and he it was who made it a commercial success. The rubber industry was thus a British industry at first.

The method of obtaining the crude rubber is to tap the trunk at a height of 6 ft. near its base by making a series of spiral cuts in the bark and drawing off the milky juice or sap into a clay cup fixed to the trunk. The rubber thus obtained is cured by a process of fumigation or smoking over a fire, the vapour of which contains acetic acid and creosote.

## Indian Rubber Plantation in India.

The Assam rubber was brought to the notice of the world by *Dr. Roxburgh*. It was first exported to London in the year 1828. The first initiative in India was taken by the Government in the year 1860, and *Mr. James Collins* was sent in 1872 by the India Office to study it in America, and *Mr. C. R. Markham* of Assam was sent in 1875 to Panama for its study. The cost of the experiment was borne by the India Government. To-day large plantations have been formed by the India Government in Assam, Darjeeling, Sikhim and Bhutan with *Ficus Elastica*.

In 1876 the Royal Botanic Gardens, Kew, London, sent out some two thousand seedlings of rubber plant to Ceylon. The seeds of the rubber plant were collected in Brazil by *Mr. H. A. Wickham*, and the plants were

transported in Warden cases which are made of portable glass-roofed boxes. And now alone in Assam, in India, there are vast rubber plantations covering eight thousand acres under European management and capital. There are also big areas under rubber cultivation in Burma, Straits Settlement, Malayan Peninsula, and Ceylon. In 1905 the plantation rubber output of India from eight thousand acres of land was 2000 tons, and the yield is increasing by leaps and bounds year after year. The exported rubber from the Federated Malayan States in 1909 was 2717¾ tons. It was practically *nil* five years ago. Thanks to the fostering efforts of *Sir Hugh Low*, the British Resident at Perak, to-day there are over three-and-a-half crores of Para rubber trees planted in the Malayan States, covering an area over two lacs and fifty thousand acres, and these trees will yield five years hence about 50,000 tons of pure Para rubber annually.

*The Selangor Rubber Plantation Co.*, Malaya, paid 287½ per cent. dividend and *The Linggi Rubber Plantation Co.*, Malaya, paid 165 per cent dividend in 1909 when rubber was selling at 6 shillings per pound.

The world's production of raw rubber was nearly 7,000 tons in 1909 and the centres of production were as follows:—

1. America (42,000 tons) .. Brazil and Mexico.
2. Africa (22,000 tons) .. Congo, Madagascar and Mozambique.
3. Australia (2,000 tons).
4. Asia (4,000 tons) .. Assam, Rangoon, Ceylon, Penang, Malay, Java and Borneo.

The "Financial Times," 72, Colman Street, London, E. C., contains a list of 109 plantation rubber producing companies that are now existing. The unique rubber "boom" of the shares of the rubber producing companies at the Mincing Lane Market of London in 1910 has been due to the very high price of rubber caused by the enormous demands of the motor-car industry and the aviation industry. In the beginning of 1908 fine hard Para rubber was quoted at 2*s*. 9*d*. per ℔, and fine plantation rubber at 3*s*. 6*d*. per ℔. In the beginning of the next year the prices rose to 5*s*. 9*d*. and 6*s*. 6*d*. per ℔, respectively; but in April 1910 the prices attained the maximum of 12*s*. 1*d*. and 12*s*. 10*d*. per ℔, respectively.

In 1902 the rubber cultivation was attempted in Cochin, Southern India, by the effort of Mr. J. R. Hunter, who opened the Palapilly Rubber Estate covering five-hundred acres. The next was the Puthukad Estate on a land of six-hundred acres leased out in 1906 to Mr. Windle. The third is the estate of the Cochin Rubber Company, Ltd., of Colombo, which covers an area of a thousand acres in all with an annual rent of eight annas per acre for the first eight years.

"The rubber plant flourishes well in a moist humid climate with a temperature ranging from 60° to 100° F. (mean annual temperature 80° F.). It does not mind a rainfall up to 200 inches (100 inches per annum), but hates the place where the rainfall is below 70 inches. It has some partiality for slopes of hills covered with forest growth up to a height of 2,000 to 3,000 ft. It has no distaste for low lands provided they are kept under proper drainage system or there is a porous sub-soil underneath. A rich sandy

loam or alluvial deposit from an elevation of 10 to 15 ft. with plenty of water-supply is the ideal habitation for the best variety of rubber." Time of sowing is from August to February.

Burma is also the home of plantation rubber and there are more than a dozen companies situated in Burma. Southern Burma,—chiefly the Tenasserim Division, Mergui, Tavoy, Hwalga, Sweggyin and other southern districts—possesses promising sites for the growth of the valuable product, and vast tracts of land are to-day cultivated in Burma. Seven-hundred acres have been cultivated in Tenasserim. The cultivation of rubber is wealth in disguise, and as the industry is still in its infancy there is every chance for an energetic Indian capitalist to be successful in this direction. A rubber tree generally begins to yield rubber when it is about 5 years old. In Burma the total expenditure per acre for five years including felling forests and laying out the ground for plantation comes up to Rs. 200 to Rs. 250. The plants are set apart generally at a distance of 10 feet to 15 feet, and about 300 trees per acre are planted, and the first minimum crop of rubber is estimated at one pound per tree, or the average yield per acre is about 200 lbs. at the lowest computation, fetching about Rs. 600 per annum at 4*s*. per lb. The yield will increase as the tree grows older. During the first four years catch-crops—such as ground-nuts, cassava, banana, cotton or even coffee or tea—can be grown. From trees five to ten years old, and grown under good conditions, an average 1 lb. to 3 lb. of dry rubber may be expected. The rubber tree is also susceptible to diseases and to insect pests. Like all other trade the price of rubber will be affected by the cycles of trade

activity and depression, and 5s. or 6s. per lb. is likely to be nearer the normal price. The wild-rubber of the Brazilian and other forests will ultimately be supplanted by plantation rubber, which in turn shall have a formidable rival in the synthetic rubber of Germany.

To-day we may be said to be living in the rubber age. Combs, pencil erasers, vulcanite penholders, stylo and fountain pens, pneumatic tyres, vehicle tyres, motor tyres, rubber tubes, elastic bands, rubber stamps, rubber shoes, tennis balls, toys, waterproofs, electric cables and surgical goods are all made of rubber.

At the present time sixteen countries manufacture vulcanized rubber, namely, England, France, Germany, America, Austria, Italy, Holland, Russia, Denmark, Norway, Sweden, Belgium, Switzerland, Portugal, Australia and Japan. Germany alone has sixty India rubber vulcanizing factories. There is also every possibility of a really successful synthetic rubber, like synthetic indigo, being invented by the German chemists though it will take a long time before chemical industry can produce cheaply vast quantities of rubber to compete with the plantation rubber. Thanks to modern synthetic chemistry the birth of *Industrial* "Twins" is no longer a freak of nature. Sir W. A. Tilden in 1891 produced synthetic rubber from isoprene derived from turpentine and vegetable oils. Dr. C. Harris of Kiel, Germany, has recently, as mentioned in the Consular and Trade Reports of May 28th, 1910, produced synthetic rubber by boiling together isoprene with acetic acid in a closed tube. As soon as commercial process of making isoprene is discovered, synthetic rubber will be cheaply made to

compete with the plantation rubber. Then we shall have two sources of rubber as we have now two sources of indigo from the plantation indigo and the synthetic indigo; two sources of camphor, the natural and the artificial; two sources of paper from natural cellulose and the artificial wood pulp; two sources of silk from the silkworm and the artificial silk; and two sources of manure, the natural nitrate and the artificial nitrate made from the air.

## Utilization of Waste India-Rubber.

The quantity of reclaimed or waste rubber is more than ten thousand tons annually (Parke's process). Mr. A. Tixier, a French Chemist, discovered that vulcanized rubber was soluble in Tirpinol upon which the regeneration of waste rubber is based. This process was patented in 1906. The inner tubes of bicycles and motor car tyres are regenerated by this process and can be easily done in India of which there is a great field.

## The Manufacture of Vulcanized Rubber.

There are three processes of vulcanizing India rubber:—

1. Goodyear's Process—consists in mixing sulphur 7 to 10 per cent. with India rubber. The two ingredients are thoroughly mixed up by grinding in the masticating machine, and subjugated to a steam pressure at 280°F. from 2 to 3 hours in a closed vessel.

2. **Hancock's Process**—consists simply in steeping a sheet of rubber in melted sulphur at 250°F.

3. Parke's cold Process—consists in dissolving the rubber in a solution of one part of chloride of sulphur to sixty parts of Carbon Disulphide and then evaporating the latter.

Machines required for vulcanization are :—

1. Washing machine.
2. Grinding and mixing machines.
3. Rolling machine.
4. Drying machine.
5. Moulding machine.

### The Manufacture of Vulcanite.

Hard rubber known as ebonite or vulcanite is produced when the proportion of sulphur is increased to 25 to 35 per cent. and subjected to a steam pressure in a closed vessel at a temperature of 310°F. (165°C.) for 6 hours, and then slowly raising the temperature 5°F. more. The process consists of the following stages :—

1. Mixing the rubber compounds (in the grinding and mixing machines).
2. Rolling into the form of sheet (in the rolling machine).
3. Making up various articles (in the moulding machine).
4. Vulcanization by steam.

After vulcanization the vulcanite is worked up in a lathe as desired and then finished by polishing in a polishing lathe.

## Polishing Materials for Vulcanite.

1. Crocus or sulphate of iron.
2. Chalk or whiting.
3. Emery powder (from Greece).
4. Oil-stone powder.
5. Putty powder or oxide of tin.
6. Rotten stone (from England).
7. Rouge or sesquioxide of iron.
8. Sheffield lime.
9. Tripoli powder (from Asia Minor).
10. Pumice stone (from Lipari).
11. Chamois leather, maize leaf and flannel.
12. Corks.
13. Felt bobs.
14. Calico mops.
15. Wool mops and brushes.
16. Linseed oil

## Notable Rubber Factories worked by Electric Power.

1. The Leyland and Birmingham Factory (Est. 1888).
2. The Siemen's Cable Works at Woolwich.
3. The Avon Rubber Co. at Milksham.
4. The St. Helen's Cable and Rubber Co., Warrington.
5. The Pirelli et Cie at Milan.
6. The United States Rubber Reclaiming Co. at Buffalo.

## The Rubber Pencil Erasers.

At first raw para rubber was used for this purpose. To-day vulcanized rubber is used for the pencil eraser.

A. W. Faber & Co. of Nuremburg in Bavaria have the prominent German Factory with a branch at New York, U.S.A.

*Vulcanite manufacturers.*—Some notable companies who manufacture vulcanite are:—

1. The Scottish Vulcanite Co. of Edinburgh which manufacture vulcanite only.
2. The India Rubber and Gutta Percha and Telegraphic Wires Co. at Silvertown near London. They have a branch office at Fairlie Place, Calcutta.
3. Dr. Heinrich Traun Und Sohn, who have got also a branch agency at London.
4. The Harburg-Vienna Factory covering seventy acres of land with a capital of ninety lacs of marks and employing three thousand and five hundred hands.
5. The American Hard Rubber Co.—Est. 1857.

In America there were twenty factories in 1900 with ten crores of rupees as capital and giving employment to ten thousand men and six to eight thousand women.

## The Manufacture of Rubber Stamps.

This manufacture consists of four operations to be followed in the order given below:—

1. Preparation of the matrix or mould in which the type letters are to appear sunk in any of the following ways, *viz.*, (*a*) plaster casting, (*b*) matrix mass, (*c*) metal matrix, (*d*) steel matrix.

2. Pressing the matrix in contact with unvulcanized sheet rubber in an autoclave press.
3. Vulcanization of the unvulcanized sheet rubber at 160°C. for fifteen to twenty minutes.
4. And finally mounting up the finished stamp on to the handle with pure rubber solution.

## Importance of Pen Industry in India.

The total population of India is nearly thirty crores and equal to that of the whole of Europe. The population of Bengal is little over seven crores. Out of thirty crores of population over one crore of males and ten lacs of females are educated in the vernaculars only. Over ten lacs of male people and fifteen thousand females are also educated in English. The Christian population of India is about forty lacs. There are over one-hundred and forty-seven different languages spoken in India. The number of Registered Printing Presses in India in the year 1902 was about two-thousand, one-hundred and ninety-two. The number of newspapers and periodicals in 1902 was one-thousand, two-hundred and eighty-three in total, *i.e.*, seven hundred and eight newspapers and five hundred and seventy-three periodicals. The number of annual publications in English is three-hundred and twelve, and in vernaculars about seven-thousand and eighty-one.

With the spread of ever-increasing education as well as population, the consumption of writing materials—pen, ink and paper—is bound to develop enormously. The statistics for 1909 shows that more than forty-three lacs of rupees worth of stationery and

more than ninety-two lacs of rupees worth of paper were imported into India. Though there are eight paper mills now in India, yet there is much room for their further development on up-to-date methods utilizing the cheaper wood-pulp. In short, we might say in the words of Mr. Gladstone, the apostle of Free-trade, that the "consumption of paper is the measure of a people's culture."

## The Evolution of the Stylo Pen.

| | | |
|---|---|---|
| Ancient.. | 1. | Stylus of metal, stone, ivory or brush. (Pre-historic). |
| Mediæval | 2. | Reed pen (up to sixth century A. D.). |
| | 3. | Quill pen (sixth century to first-half of the nineteenth century). |
| Modern | 4. | Quill nib (1803). |
| | 5. | Barrel nib (1803). |
| | 6. | Steel nib (1830). |
| | 7. | Reservoir nib. |
| | 8. | Gold nib (1860). |
| | 9. | Twisted rigid stylus glass pen. |
| | 10. | Fountain pen (1860). |
| | 11. | Stylo pen (1880). |

### Summary of Improvements in Stylo Pen.

I. The wire-feed—

(1) Movable coil-spring feed as in A. T. Cross' stylo.

(2) Fixed coil-spring needle feed as in 'Pelican' stylo.

(3) The fixed needle feed as in A. W. Faber's 'Independent.'

(4) The drop needle feed as in "Gravity" stylo.
(5) Wireless or no needle feed as in Dr. R. N. Saha's pen.

II. The air-vent and air-tube modifications—
(1) Situated at the top end of the barrel.
(2) ,, at the side of the barrel.
(3) ,, at the annular groove of the writing section as in gravity-stylo with no air-tube.
(4) Double-notched grooves as in "Onostyle."
(5) Double air-vents and no tube (in Dr. R. N. Saha's pen).

III. Protection of the air-vent (to prevent leakage)—
(1) Screw-ring as in A. T. Cross' stylo.
(2) Slide-ring or sleeve as in 'Independent' stylo.
(3) No ring.
(4) Screw plug as in self-filling "Onostyle."
(5) Air-trap as in "Nota Bene" stylo.

IV. The cap—
(1) The rubber cone inside the cylindrical cap as in "Independent" stylo.
(2) The cone cap.
(3) The screw cap as in Dr. R. N. Saha's pens.
(4) The holes in the cap (to prevent compression).
(5) The notch in the writing section and no holes in the cap.

## A List of Notable Steel Pen Makers.

1. The celebrated Joseph Gillot, Birmingham.
2. The celebrated William Mitchell, (J. and G. nibs), Birmingham.
3. Macniven and Cameron (Waverly nibs), Edinburgh.
4. Easterbook & Co.'s "Relief" pen No. 304.
5. Hinks and Wells Co., Birmingham.
6. Perry & Co., ,,
7. Myers & Co., ,,
8. John Heath, ,,
9. Geo. R. Hughes, ,,
10. Setten and Durward, ,,
11. John Mitchell & Co., ,,
12. William Collin Sons Co.
13. Brandauer & Co.
14. H. Hewitt (Ball-pointed pens).

## A List of Fountain Pen Makers.

1. Messrs. Mabie, Todd and Bard, London and America, established 1843, makers of the celebrated "Swan" fountain pens, patented in 1886, 1888 and 1895.
2. L. E. Waterman & Co., 173 Broadway, New York, the celebrated fountain pen makers of America, patented 1884.
3. Messrs. T. De La Rue & Co., London and America, makers of the celebrated "Pelican," "Nota Bene" stylo, and "Onoto" and "Onostyle" self-filling fountain pens.
4. The Jewel Pen Co., London, established 1884.
5. The Eagle Pencil Co., New York; makers of glass barrel fountain pens, patented 1890.

6. Moore's non-leakable fountain pens.
7. Dr.. Faber self-filling pen, Toledo, patented 1903. Ohio (U.S.A.).
8. A. W. Faber "Independent" stylo, U.S.A.
9. Burge, Warren and Ridgley, London, celebrated makers of the "British stylograph pen."
10. The Dupleix standard self-filling pen, Toledo, U.S.A.
11. Parker and Lawrence fountain pens.
12. The A. T. Cross stylo pen patented in America, 1878, and in England, 1879.
13. Paul Ewart Bloomsbury, America.
14. The Conklin Pen Co., Toledo, Ohio (U.S.A.).

## The History of the Lead Pencil Industry.

The lead pencil as its name implies was first suggested from metallic lead which easily scratches on paper. The lead pencil is, however, made from graphite or plumbago also named "black lead" from its resemblance to ordinary lead. The lead pencil industry was founded in England. After the discovery of the famous Borrowdale Graphite mine in Cumberland in 1565 graphite was used in pencil-making, and from this time as long as the Cumberland mine lasted England enjoyed the monopoly of the lead pencil industry. It then found its way into Germany and thence into America. The first pencil factory in Germany was started in 1761 by Mr. Casper Faber of the famous Faber family in Nuremburg in Bavaria. It was introduced into America in 1861 by Mr. Eberhard Faber of the same Faber family in New York. This was soon followed by four other firms. Nuremburg

became the chief centre of pencil industry for more than a century. To-day there are more than twenty-six factories in Germany employing five thousand and five hundred persons and producing two hundred and fifty millions of pencils annually, valued at sixty lacs of rupees. About the year 1795 Corte of Paris devised the improved process by which the modern pencils are now manufactured. The Japanese have also begun to manufacture lead pencils in a metallic case.

## The Pencil-making Plant.

1. Sawing machine.
2. Grooving machine.
3. Shaping or moulding machine.
4. Sizing machine, sand-papering machine.
5. Edge-smoothing machine.
6. Colouring or varnishing machine.
7. Stamping press machine.
8. Pulverizing machine.
9. Filter press.
10. The Hydraulic press or the graphite thread drawing machine.
11. Muffle furnaces and crucibles.

## The Manufacture of Lead Pencils.

When the graphite was found pure as in the Cumberland mine, the pencil was then made by simply encasing in wood thin square slices or strips of ordinary pencil length of graphite sawn up from blocks of solid graphite The modern lead pencil is made from a core formed of an intimate mixture of purified graphite, plumbago or black lead and pipe-clay free

from sand and iron, and then encased in a groove of cedar wood, polished and lacquered, and afterwards stamped with the maker's name and design. The graphite is at first purified by finely dividing it in large pulverizers and washing them in tubs of water, and then the fine graphite is filtered through filter presses. The plastic mixture of purified graphite and clay is then passed through hydraulic presses containing dies whose holes are formed of saphires, and the graphite strings which come out through the holes of the dies are cut into seven inches of length, and then fired in muffle furnaces by placing them in crucibles. The wood generally used in pencil-making is red cedar wood growing in Florida and Alabama in America. The cedar wood is soft, durable, compact and fragrant as also close-grained and hence capable of taking a good polish. Cedar wood is, therefore, almost exclusively used by pencil makers. In India cedar wood is said to be had in the Trichinopoly forests, and a kind of white wood which is found in Vizigapatam may be used for the same purpose.

The graphite to-day used in pencil comes chiefly from the mines of Mexico, Eastern Siberia, Bohemia, Ceylon and Vizigapatam. By automatic circular saw the wood is cut into narrow strips, 7 inches long, 2½ inches wide, ¼ inch thick, which being thoroughly dried are passed through automatic grooving machine which cuts a groove along the middle of each strip in one of its faces. The "leads" are placed in the groove of the strip of wood, and over it is placed another small piece of wood, the two pieces being fixed with glue. The pencil thus prepared is now passed through a moulding machine to give it its proper form, round or hexagonal, or as desired. The pencils are now

polished by a sand-papering machine and then varnished mechanically by a varnishing machine or by the hand process for the costly pencils. The ends of the pencils are next trimmed by sharp knives of a smoothing machine. Stamping operation by means of a stamping press now follows, by which thin strips of gold or silver leaf is stuck into the wood by a heated steel die, the heat of the die causing the gold or silver leaf to adhere to the pencil. The completed pencil may now have an addition of a metal tip and a rubber eraser.

THE SUMMARY OF THE PENCIL-MAKING PROCESS.

1. At first the graphite is ground to a fine powder by means of a pulverizer machine.
2. Next it is washed in tubs until pure.
3. Then it is intimately mixed with pure clay in various proportions.
4. The plastic mass is now solidified by pressure into strings when passed through a Hydraulic Press.
5. The graphite strings are finally fired and dried in muffle furnaces.
6. The "leads" are encased in wood and finished by automatic machines mentioned above (Nos. 1 to 7).

## The Manufacture of Coloured Pencils, Slate Pencils and Chalk Pencils.

*Coloured pencils.*—Consist of a mixture of clay and mineral colouring matter, wax and tallow.

*Copying ink pencils.*—Consist of a mixture of aniline dye with clay and gum.

*Slate and slate pencils.*—The manufacture was also a

British industry at first and was begun in the eighteenth century. The finer varieties of slate are made into writing slates and slate pencils. The slate and slate pencil industry of North Wales, Cumberland, Devon and Cornwall was famous

*Chalk pencils.*—The black chalk is used for drawing or writing. The French chalk and coloured crayons are used for writing on black boards in schools and colleges.

The chalk or the lime-stone rock is formed of the dead bodies of the shells of Foraminifera.

## The Type-writer—its History.

As a writing machine the modern American type-writer has effected a perfect revolution in business correspondence and plays an important part in the Secretary's art by doing away with good handwriting and facilitating the cheap production of manifold writing and the process of handwriting. Stencilling carbon copies, hektograph, lithograph, type-writer, cyclostyle, Trypograph, and Envelograph are the machines used for this purpose. The modern Duplicating machine can perform two-thousand to three thousand copies per hour and can be used also as an office printing press.

The innovations of yesterday are the necessities of to-day. The type-writing machine is no longer considered as the invention of the crank but is an important cog in the office machinery. The old-fashioned copying screw press is becoming a thing of the past. Rapid letter-copying machines can copy matter varying in size from post-cards to foolscap, and sixty

copies can be obtained in two minutes. The type-writer as a swift substitute for the pen was invented in America in the year 1873 A.D., known as the Remington "Standard" type-writer Other inventors followed and three principal forms of machines are now used, namely, the *Type bar machine*, the *Cylinder machine* and the *Wheel machinc.* Forty words per minute can be easily attained on the Remington type-writer, which is almost three times the speed of handwriting.

## The Wood-engraving.

*Various methods.*—Engraving is an ancient art. Block printing from engraved wooden blocks originated among the Chinese as early as 930 B.C. Engraved works on metal, stone and wood of great antiquity may still be found.

*Xylography* or wood-engraving is used for illustrating printed matter but photography to-day has largely superseded the wood-engraving as well as stone-engraving or *Lithography* invented by Senefelder, a dramatic author in 1796.

*Copper-plate engraving* said to have been discovered by a Florentine goldsmith and artist named Finiguerra about 1440 was further improved by Col. Ludwig Von Siegen, known as *Mezzo-tint engraving* about 1643.

*Steel-plate engraving* superseded copper-plates by the invention of Jacob Perkins in 1837 and was once the most famous process of illustrating before the development of the half-tone processes about 1870 to 1890.

## The Photo-engraving.

1. *Line blocks* are used for the reproduction of designs drawn in line, dot, in ink, crayon, or charcoal and can be done by (*a*) wood-engravings or by (*b*) process blocks. The illustrations may be photographed or drawn by the artist on a finely prepared surface of box-wood and then the design is raised in relief by means of gravers. A process line block is less expensive than wood block as the former is made mechanically in which case the design is photographed, enlarged or reduced as required and a print from the negative is made on a prepared sensitized surface of zinc or other metal, and the metal plate is afterwards etched by an acid bath. The plate is then warmed to make the ink tacky and then dusted over with dragon's blood which adheres to the ink. The plate is again warmed which melts the dragon's blood, running down over the sides of the lines, and being cooled, forms an acid resisting varnish, so that the plate can be further etched, if necessary, for three or four times when the drawing is left on the metal in relief and the block ready for printing. Duplicates for line blocks whether in woodcut or process engraving are made by stereos or electros which are castings obtained by different means. (1) *A stereo* is made by a papiermaché impression of the original block from which castings in metal are taken. (2) *An electro* is made by depositing copper electrically on a wax impression of the original. An electro can further be steel or nickel-faced to make it more lasting.

2. *Half-tone blocks.*—Photo-engraving to-day is a prominent feature in cheap illustration for books,

magazines and newspapers. It is the photo-mechanical process by which photographs, wash-drawings and paintings, in a form suitable for printing with letter-press at one operation, are reproduced at pleasure. The pictures are photographed through a "screen" for the purpose of breaking up the surface into minute dots. For Art magazines and books a "screen" which breaks the picture into 150 dots to the square inch is used, and for a newspaper a "50" screen is used. Four principal methods of photo-engraving are in use, namely, (1) photo-etching or zincography for line block, (2) half-tone process copper blocks for finer works, (3) the three-colour process for coloured illustrations (1895), and (4) the gelatine or collotype process.

## The Process of Half-tone Block Making.

The mechanical process of the half-tone copper plate for the printing press has wrought a revolution in the production of cheap and better illustrations for books and high class magazines or periodicals. With the introduction of half-tone blocks and the three-colour process blocks as also two-colour process blocks, the wood-engraving, lithography and chromo-lithography are losing their grounds. In a photograph, as in a black and white drawing, the shades of colour between light and shadow are termed "half-tones." For the purpose of letter-press printing which requires relief blocks the process of relief in half-tone blocks is attained by means of a graduated grain or by fine lines or by tiny dots of varying size. The half-tone process was introduced about 1870 and greatly improved by 1890 when it came into common

use. By means of etching the copper plate the parts that are to appear white in the print are eaten away, leaving the half-tone dots produced by the "screen" in relief so that these dots alone will receive ink on the printing press.

The *copy* for the half-tone process is usually a good photograph or a wash-drawing of the required illustration. It is retouched first, where necessary. From this copy the first step in the production of the half-tone plate is the making of the half-tone "screen" negative of the original drawing or photograph copy by the Wet-collodion method in which the photographer makes his own negative plates. The photographic copy is fixed to a *copy-board* in front of the camera and then focussed properly. The half-tone *camera* is more bulky on account of holding the screen gear and is made very rigid and parallel in all respects, and provided with both the front and back bodies movable. The *negative glass plate* is freshly made with nitrate of silver bath or iodized collodion and put into the plate-holder which also contains a ruled glass 'screen' called the *half-tone screen* or diaphragm made up of two glass plates, having coarser lines for newspaper printing which requires "50" lines per square inch, or having finer lines as close as "175" to "200" lines per square inch for art magazines or books. There is only a limited number of half-tone screen makers : Levy of Philadelphia, U.S.A., is the oldest and most famous worker, Johnson and Brown are two English makers of screens at Leicester. Haas and Illig in Frankfurt-on-the-Maine are two makers of Germany.

The screen and plate-holders with screen adjustments are made by various makers such as the

Scovill-Levy-holder Co., and the Penrose and Co. Of the automatic methods of adjusting the "screen" and of indicating its correct position proportionately to the extension of the camera. there are two or three forms which have been patented. The simplest apparatus is that invented by Mr. U. Ray, B.A., of 22, Sukea's Street, Calcutta,—the famous process artist of India.

The collodion sensitized negative glass plate having been exposed in the camera the negative is developed in the ordinary way in the dark room much like that of any other negative. The half-tone camera lens, it should be noted, is of long focu., of the rapid rectilinear type, a 9 in. focus lens is used for a half plate size 6½ in. ×4¾ in. *Cooke's process lens* are specially designed for process reproduction. The image in the negative plate appears in about five seconds during the process of development, and the plate is then *fixed* with a solution of potassium cyanide The negative is now dried and coated with a solution of India rubber followed by another coating of collodion. If it is required to get a printed image like that of the copy, then the image of the negative should be reversed by stripping the film from the negative glass plate by cutting with a sharp knife the portion of the film, and placing it in an acid bath for the purpose of loosening it from the glass, when the desired portion may be easily removed, reversed and transferred to a thicker glass plate. In taking the negative a *mirror* or *prism* might be used to reverse the image of the copy and the laborious process of stripping the film might thus be avoided.

The second step is the printing of the copper plate from the negative glass plate. This is not like ordi-

nary photo print in paper, for instead of paper a copper plate is printed photographically direct from the glass plate negative. The copper plate can be had polished ready made. It is also polished a second time by rubbing it with willow charcoal and water. It is then dried and coated with a sensitized collodion solution of ammonium bichromate with the help of a whirler. The prepared copper plate is now placed in a heavy printing frame. The negative is placed below the front glass of the printing frame with he face of the negative in contact with the ensitized copper plate and the back of the printing frame is properly secured. The frame with the greatest number ot screws at the back is the most popular. A good printing frame is introduced by Penrose & Co. Day light or electric light is used for printing the opper plate w... h requires from five minutes to half-an-hour. For day-light exposures an *actinometer* should be used which indicates the proper exposure. The actinometer consists of strips of paper so ar... nged as to form steps according to the number of papers forming a mask behind which a piece of sensitive paper such as an ordinary P.O.P. is placed; when a certain number is visible on the sensitive paper, the plate will be fully exposed.

The copper plate being printed, its image is *developed* under a jet of running water with a solution of violet dye, which renders the image to be visible to the naked eye. The image is then *burned* over a gas stove till it turns to a purple-brown tint. A good stove is required for *burning* in of the copper plate after development. Penrose & Co. have introduced a good *gas stove* with three burners. The plate is held over the fire with plate tongs. After burning the plate is

allowed to cool on a *piece of asbestos* placed over an iron plate. The plate is now immersed in an *etching bath* of nitric acid or perchloride of iron. For etching with perchloride of iron an etching stoneware or porcelain tray is used and a Beaumé hydrometer is required to find the density of the solution made by measurement in a small earthenware jug. A fine sable brush and a square steel point set in a cedar handle are used as "*scratcher*" for clearing up and retouching the plate. *Gravers* might also be used where the plate is to be elaborately retouched by the engraver with the help of engraver's magnifying glass. The *ruling of the border line* may be done by a *ruling board* and for ruling circles or elliptical border lines an *elliptograph* machine may be employed. For lettering the name in a block a *stamping press* may be used For taking proofs from the plates, when the operations are finished, a *lithographic* press being much cheaper may be used instead of a type-press.

During the process of etching, the margins and back of the plate are protected by a coating of shellac. The etching takes from twenty minutes to an hour. The mounting of the plate on the wooden block may be done entirely by hand by means of a treadle circular saw, a jig-saw and a *shoot and bevel plane outfit.*

With the exception of a few wood-cut blocks used in this book, the others are all half-tone blocks and are made from Photographs taken by the author for illustrating this book.

The plate may also be mounted by filing or cutting the edge flush and by glueing the plate on to the wood, or by soldering small brass screws on to the back of the plate. By means of a *Routing machine* and a *Bevelling machine* the edge of the plate may be

finished artistically, after which the plate is ready for mounting or blocking; by this process it is nailed to a wooden block ¾ of an inch high, care being taken to ensure the plate and the block together to be of the same height as that of the printing type. The block is now ready for "*proving*" which is done on a hand-press; when this is done it is ready for the printing press.

*The three-colour process* is very like the half-tone process—only instead of one, three separate blocks are made from three distinct negatives of the original taken through three primary coloured filters—yellow, red and blue-green—on especially sensitized negative plates. This process was introduced about the year 1895.

The printing from the three blocks with respectively yellow, red and blue ink will, if superimposed, give a faithful coloured facsimile of the original painting in eight or ten colours. Three-colour blocks take about two weeks to make and are very expensive. The largest colour block that is now made is 24 inches by 20 inches

*Two-colour process*.—This process is very cheap and is suitable to illustrate catalogue covers and booklets.

3. *Lithography.*—Stone-engraving was invented by Senefelder, the Italian dramatic author and musician, in the year 1796. Chromo-lithography or colour printing was introduced about the year 1868. The principle of printing by lithography depends on the stone's receptiveness of grease and water and their antagonism to each other. The lithographic crayon is composed of ink, chalk and grease by which the design is drawn on the stone or transferred thereto, from a drawing on specially prepared paper. The stone is then given a slight etching by an appropriate

acid. The process of printing consists of keeping the surface of the stone moist by a damping roller, and supplying the design with colour from a roller charged with greasy printing ink. Then passing a sheet of paper over the stone under pressure through a suitable press, a portion of the ink is left on the paper. For producing pictures its advantages are its cheapness and large size. Recently chromo-lithography has been greatly improved by the discovery of light *Aluminium* plates, replacing the costly, heavy and fragile lime stones of Hohenlofen in Bavaria. By means of chromo-lithography beautiful Christmas cards and all sorts of floral pictures, high class labels, illustrated signs and advertising matter of all sorts are to-day largely supplied.

## The Stenography or Short-hand.

*Stenography or short-hand* is the system of brief handwriting which enables a person to write legibly and quickly at the rate of speech. The modern short-hand is that of Isaac Pitman's Phonography introduced in the year 1837. There are 281 systems of short-hand that have appeared up to now. Phonography is admirably adapted to the purpose of *verbatim* reporting of the speech of a rapid speaker in the platform or the office. Pitman's method can be acquired by an intelligent person in a few weeks, as it is mainly a matter of practice generally for six months.

## Correspondence by Post—its History.

The art of writing disseminates knowledge by means of the printing press in the form of books,

newspapers and magazines or periodicals; but since the introduction of a cheap postal system, a great volume of individual communication from one place to another all over the world to-day is done by hand-written or type-written correspondence.

The growth of the Postal system with the introduction of a cheap and rapid delivery of letters of the present day has supplanted the old method of post-boys, post-horses and the state-coaches with armed guards. The *Penny Postage system* came into force in England in the year 1840, through the efforts of Mr. (afterwards Sir) Rowland Hill. Inventors were engaged in finding out mechanical improvements and new processes for the manufacture of adhesive postage stamps. *Mr. James Chalmers* first made the adhesive stamps in 1834. Mulready's embossed envelopes and covers were introduced in the year 1840. Through the combined efforts of *Mr. Edwin Hill* who designed the stamp and *Mr. Perkin* who engraved the design, the adhesive postage stamps were successfully introduced to the public. Engravers, printers, chemists, and artificers all combined to produce stamps in which both cheapness and security against forgery were attained. *Messrs. De La Rue & Co.*, in 1856, obtained the monopoly of adhesive stamp manufacture from the British Government. Within the course of seven years the postage stamp was adopted in Switzerland, the United States, Russia and Brazil. France introduced it in 1849. Austria, Prussia, Saxony, Spain and Italy followed it in 1850. In 1853 the admirable invention of perforating the stamp-sheets was patented in England by Mr. Henry Archer, which patent was purchased by the Government for £4,000.

## A New Postal Invention.

"A new invention in this connection deserves a passing notice. At the suggestion of his relative Rai S. B. Dutt Bahadur, retired District Engineer, Comilla, now State Engineer to the Maharajah of Tipperah, Dr. R. N. Saha of the "wireless stylo pen" fame and the pioneer of stylo-pen industry in India has also successfully discovered and invented a process of *preventing the stickiness of adhesive stamps and envelopes* from the action of moist weather. The paraffin booklet stamps recently introduced for this purpose are costly to the Indian Government. His process is very economical and very simple and will cause a great saving to the stamp office, if introduced by the Indian Government, and will be also a great convenience to the public, who will have the benefit of buying even quarter-anna adhesive stamps and all sorts of envelopes at their actual price." The total value of postage stationery issued in 1909-1910 amounted to over three crores of rupees, (service stamps and stationery = 46 lacs, quarter-anna adhesive stamps = 185 millions, half-anna stamps = 110¾ millions, and small half-anna envelopes = 69 millions).

It is worth mentioning here that Messrs. Jhamman Lal and Bed Ram's patented invention of the "Impervis Invisible Shackle Padlock," manufactured at Aligarh, U.P., is being largely used by the Indian Postal Department.

Next to our faculty of speech and vision, is the great boon of the Postal system which is a common necessary means of epistolary correspondence of our modern civilization. The post office in India dates from 1837 with the accession of Queen Victoria. By an Act of

1837 a public post was established in British India by the East India Company. The conveyance of letters was conceded to private persons only as a privilege, and the charge was levied in cash instead of in postage stamps. From Calcutta to Bombay the charge was one rupee per tola The introduction of the *half-anna postage system* in India was made by Lord Dalhousie about 1853, simultaneously with the inauguration of the Railway, the Electric Telegraph, the Irrigation Canals and good Trunk Roads and the famous Education Despatch of 1854, which conferred on the Indians the great boon of English Education.

The *one-pice post-card system* introduced in the year 1879 has further facilitated written correspondence from one part of the country to the other. The Indian Postal Service affords employment to nearly a lac of persons including twenty-five thousand postmen who carry on their duties with wonderful zeal and remarkable fidelity. The number of post offices in India is over eighteen-thousand and letter-boxes over forty-three thousand. More than eighty crores of letters, packets and newspapers are delivered in a year. The extent of the commercial services that are done by the Indian Post Offices may be estimated from the stupendous amount of work done; nearly six millions of parcels by V.P.P. valued at 7¾ crores of rupees annually pass through them. The V.P. Parcel system affords marvellous facility to the tradesmen doing mofussil trade. The value of Money Orders issued by the Post Office has risen from a crore to over 42¾ crores of rupees in about thirty years. The Savings Banks opened in the year 1882, to-day numbering over eight-thousand, contain depo-

sits of over fifteen crores of rupees and the number of depositors is over thirteen lacs.

*Postal Telegraph Offices.*—The total number of combined Post and Telegraph Offices in 1909 was 2,378 employing 3,455 signallers and 1,067 boys employed as messengers. In 1857 telegraph offices numbered only a few scores with 3,000 miles of single wire and to-day 12,000,000 messages are transmitted annually over 270,000 miles of wire. The telegraph system is a great factor in the industrial progress as well.

A curious insight into the human nature is obtained when it is noticed that in Bengal, Madras and Bombay alone about 136 articles are posted daily with no address whatever and many of them even containing money or valuables.

## The Typography and the Press in Europe—their History and Results.

The Typography or writing by types is the art of printing which is the preserver of all other human arts. After Guttenberg's invention of the hand printing press in the fifteenth century in Germany, printing did not assume a gigantic industry until the lapse of about three-hundred and fifty years after its introduction into England by Caxton about the year 1470 A.D. The power printing press was introduced into England about 1814. Up to 1800 there were only wooden hand printing presses, printing two-hundred copies per hour; then iron-hand presses were introduced. In 1814 the first power printing machine was introduced into England by John Walter, the proprietor of the "Times" of London, in spite of a bitter and violent opposition of the printers who feared their occupations were gone.

About 1840 single cylinder presses were used, printing five hundred to one thousand sheets of paper per hour. By 1850 R. Hoe & Co. introduced the double cylinder machine, soon followed by four cylinder, eight cylinder, and then ten cylinder press In 1876 the modern web-press was introduced. To-day a modern newspaper machine can print fifty thousand of both sides of an eight-page newspaper in one hour, cut the paper, fold it and paste in the pages and then hand out the complete paper ready for sale. *Book-binding* is not done to-day by the hand, but by automatic machines, namely, book-folding machine, guillotine machine, sewing machine, rounding machine, cover machine, pasting machine and the hydraulic machine so that a modern book-case machine factory can turn out two thousand complete bound books every hour.

Composing machine have come into general use from 1890. They were invented by Mergan Thaler of Germany, known as the Lino-type machines, followed by the Lauston Mono-type setting and casting machines, the Dow-type setting machine and the Wick's type-casting machine. The "Bhiso-type" composing machine is a new improved form of type-casting and type-setting machines invented by Prof. S. A. Bhisey of Bombay.

Statistics of 1904 shows that the number of newspapers excluding magazines or periodicals published in the globe is as follows:—

| | | |
|---|---|---|
| 1. | The United States and Canada .. | 21,451 |
| 2. | Germany .. .. .. | 7 500 |
| 3. | Great Britain .. .. | 9,500 |
| 4. | France .. .. .. | 4,500 |
| 5. | Japan .. .. .. | 2,000 |
| 6. | Italy .. .. .. | 1,500 |

| | | |
|---|---|---|
| 7. | Austria | 1,200 |
| 8. | Holland | 300 |
| 9. | Belgium | 300 |
| 10. | Spain | 850 |
| 11. | Russia | 800 |
| 12. | Greece | 600 |
| 13. | Switzerland | 450 |
| 14. | Australia | 800 |
| 15. | Asia (excluding Japan) | 1,000 |
| 16. | All others | 1.000 |

## The Typography and the Press in India—their History and Results.

Before the advent of the art of printing book-making was done by the slow and laborious process of handwriting or penmanship Handwriting was then made on palm-leaves or on hand-made paper, and the unstitched loose sheets containing the manuscripts were covered by wooden boards and tied round by cloth. As versification helped memory, Indian literature in ancient time was composed mostly in verses or *slokas* and handed down to posterity as *Sruti* or oral tradition with the help of Vocal Education, and as *Smriti* written in manuscript with the help of memory. But as memory is evanescent and not infallible as a recording agent of human wisdom and thought, interpolations and human caprices actuated by greed and pretence worked havoc in the book lore of the pre-printing ages. The art of printing is said to have been invented about the ninth century A.D. by the Chinese—Phoongtao and Pyching—who used wooden types. Guttenburg in Germany invented the art of printing in Europe about 1436, and Caxton introduced

it into England about 1470-80. The art of printing was not known in India as literature and learning were zealously guarded from being diffused into the masses. It was introduced into modern India with the revival of Western Education. A committee of Public Instruction was formed, receiving an annual grant of one lac of rupees about 1813 with the renewal of the East India Company's charter.

Mr. Charles Wilkins, a lover of Oriental languages, invented the types of both the Bengali and Sanskrit alphabets after he had learnt Bengali and Sanskrit. The College of Fort William was established already in the year 1800 by Lord Wellesley to teach the civil servants the language of the country. Thus English Education in India commenced in Bengal. Bengali books were written for the Fort William College by Mrittunjay Tarkalankar, Rajib Lochan Mukerjee, Ram Ram Bose, Chandi Charan Munshy and Hara Prosad Kar. India owes much to Christian missionaries. By the philanthropic labours of the reverend missionaries—Marshman, the son of a weaver, Carey, the son of a shoe-maker; and Ward, the son of a carpenter—the first printing press and a magnificent college were established at Serampore in Bengal about 1822. They also published the first Bengali Grammar and Dictionary. In 1818, Marshman published the first Bengali newspaper named "Samachar Darpan" which afterwards ceased to exist in 1841. The first Bengali nautical almanac or "Panjika" was also issued from Serampore in 1818. In 1819, the great Hindu Reformer and the founder of the theistic Brahmo Samaj—Rajah Ram Mohan Roy—through whose exertion the burning of the *sati* was abolished, published the next Bengali magazine named

"Kaumudy." Babu Bhabani Charan Banerjee then started the Bengali daily "Samachar Chandrika" in 1822. Iswar Chandra Gupta, the first Bengali poet of the nineteenth century, started in 1830 the daily newspaper "Sambad Provakar" which was followed by "Sambad Purna Chandrodaya" in 1835; "Sambad Vaskar" in 1839; "the Government Bengali Gazette" in 1840; the "Tattvabodhini" magazine in 1843; "Bamabodhini," "Somprokash" and the weekly "Education Gazette" of Chinsurah.

## Sanskrit Literature and Art before the days of Printing, 2000 B.C.—500 A.D.

The Hebrew Language, the Greek Language, the Latin Language and the Sanskrit Language are the four dead or classical languages of the West and the East. They are called "classical" because they are taught only in school classes now-a-days.

In the Age of speaking and singing the intellectual and spiritual record of man was in the form of oral traditions. Hindu poetry had its early origin in the Vedic hymns. For more than fifteen centuries there was an uninterrupted stream of Sanskrit literature. In ancient India there were four famous seats of Learning—namely, Navadwipa, Benares, Mithila and Kanchi. The monastery of Nalanda in Behar, now in ruins, at one time provided free boarding of over ten thousand scholars. Before the advent of the Age of writing the four *Vedas*—Rig, Sama, Yajur and Atharva—emanated from the four mouths of the creator Brahma, and were therefore known as *Sruti*, *i.e.*, revealed knowledge. Gradually the *six Vedangas*, consisting of *Laws and Ritualism* known as Kalpasutras,

Pronunciation, Grammar, Philology, Prosody and Astronomy; the twenty-four *Sanhitas* including the famous code of Manu; the two great historical Epics —the Ramayana of Valmiki and the Mahabharata of Vyasa with its immortal Gita Philosophy; the eighteen *Puranas*; the eighteen *Upapuranas*; and the *Tantras* were written in the Age of Writing. There were two distinct classes of literature that sprang into existence from the primitive mythological stratum of thought of the pre-historic Vedic Age—the one forming the Brahminical ceremonial lore or Vedangas and the other the Brahminical philosophy of the Upanishads. The six *Darsans* or Schools of Hindu Philosophy gradually arose out of the metaphysical speculations of the Upanishads, namely—(1) the Sankhya Philosophy of Kapila or the enumerative philosophy of self—being the first system of mental philosophy of the pre-historic world; (2) the Yoga Philosophy or concentration of mind founded by Patanjali; (3) Nyaya Philosophy or Hindu Logic of Gautama being the first system of logic of the ancient world, not unlike the syllogism of Aristottle; (4) the Baisesika Philosophy of Kanada propounding the Atomic Theory of the East; (5) the Jaimini Purva Mimansa Philosophy and (6) the Vedanta Philosophy of Uttarmimansa of Badarayana Vyasa, proclaiming the Supreme Being as the Universal Soul of the Upanishads and arriving at the bold conception that the human Self and the Divine Universal Self are the one and the same, and that the Divine alone is real and that the mundane world—though eternal, retributive and full of bitter pain—is after all but a mirage or "maya." It was thus by way of reaction of the undue restraints that the Hindu mind was allowed to indulge in the most unrestrained

freedom in the world of thought in their schools of philosophy. The metaphysical philosophies of the later Greece or Rome are as dull and feeble as are the voices of the prattling child before the etherial emanations of the Oriental mind.

It was during this "Rationalistic Age of India" that the ancient Hindus made a great advance in the Science of Mathematics. In Arithmetic, Geometry, Algebra and Trigonometry, the modern world is indebted to the Hindus from whom the Saracens of Egypt and Syria learnt them and afterwards introduced them into Western Europe. The Hindus invented the famous Decimal System of Notation in Arithmetic, they knew the simple Rule of Three, they could extract square and cube roots. In Algebra they knew the different Laws of Proportions and could work out sums in permutations and combinations. In Trigonometry they were acquainted with every rule except those requiring logarithmic calculations. In Geometry they made a very great advance in ancient time and it was borrowed by Greece. Geometry originated from the Kalpasutra rules for the construction of the Vedic altars formed in all possible sorts of Geometric forms and figures.

Panini achieved the greatest success in the science of Grammar and Philology discovering the 1964 primitive Sanskrit roots of words, not unlike the later Greek and Latin roots. Patanjali, the celebrated Sanskrit Grammarian, flourished about 180 B.C. Bopadeva Goswami wrote his famous "Mugdhabodha" Grammar about the twelvth century A.D.

The sciences of Astronomy and Chemistry had their first origin from the Astrology and Alchemy of ancient India. In Astronomy the Hindus excelled all other

ancient nations. The Hindu Astronomy was vastly superior to the later Astronomy of the Arabs and the Chaldeans. The Hindu Astronomy, the first born of the natural sciences, had its origin from the worship of the Vedic Gods. To India the Western world owes the division of time into weeks of seven days each and the division of twelve solar months. It was from India, and not from Egypt or Assyria, that Greece derived her intellectual life in her architecture (in which she excelled her afterwards) and her sculpture, her science, her philosophy and her mathematical knowledge; and but for this scientific heritage and older civilization of India the real civilization of modern Europe would not have yet dawned upon the earth. The astronomers—Garga and Parasara—flourished in the Vedic Age. Arya-Bhatta in the fifth century A.D. determined that the earth is round and has a diurnal motion on its axis Arya Bhatta, Barahamihira, Srisena and Vishnu Chandra also offered the true explanation of the solar and lunar eclipses before Astronomy degenerated into the later Indian Astrology, and the 8th planet, the demon Rahu was invented as the cause of the eclipses. Long before the birth of Galileo and Newton, Bhaskaracharyya proved that the earth is round and that it is self poised in space and that it attracts things to it by the laws of gravitation (in the twelvth century). Brahma Gupta, Barahamihira, Khana—the lady astronomer of the sixth century A.D.—Vaskar Munjal, Vattotpal, Setotpal, Barun-Vatta, Bhojraj, Kalyan Chandra and Lilabati—the famous lady mathematician and astronomer—are a few names immortal in the history of Hindu Astronomy.

For thousand years during the Buddhistic Age from

500 B.C. to 500 A.D., Architecture, Sculpture in stone, wood, ivory and metal and Painting attained their highest development in India, which were destined to culminate in the later nobler productions of Greece and Italy. The marble *stupas* of Amaravati, the stupas of Sanchi in Bhopal, the Sarnath *stupas* at Benares, the great *stupas* at Nepal, the Chaitya at Karli in Bombay, the Ajanta Vihara or Monastery, the ruined monastery of Nalanda in Behar and the great temple at Bodh Gya, all testify to the excellence which that art attained in ancient India. In Architecture and Sculpture, in Building and Civil Engineering the Hindus were not inferior to the Egyptians, the Babylonians, the Greecians or the Romans. Various Jain temples at Benares, at Somnath at Abu, and at Giridi, the Asoka pillars, the famous solid iron pillar of Chandra Gupta II in Delhi, the temple of Jagannath at Puri, the temple of Bhuvaneswara, the Southern India temples—specially the grandest Madura temple of Siva, all bear testimony to the excellence of the art in the Buddhistic, Jaina and later Hindu periods.

The science of Medicine and Surgery known as Ayurveda made also vast progress during the Buddhistic period. Nagarjuna, Charaka, Susruta, Bagvat, Bhava Misra, Chakradattapani, Madhava nidana, Sarngadhara, Rasendra Chintamani, Bhela and Jatukarna being the highest names in Hindu medicine or Ayurveda. The great Nagarjuna founded the Science of Chemistry. Hospitals for men and beasts were founded mainly during the reign of Asoka.

The science of Music and Dancing were also highly cultured by the Hindus long before Athens and Rome appeared in the arena of civilization. During the

period of Revival of Hindu national and religious life in the fourth century A.D., Arts, Literature and Science were greatly encouraged throughout the reigns of the Great Vikramaditya and Siladitya.

In Sanskrit Drama (Epic, Lyric and Drama—Poetry) the dramatist and poet Kalidas, who flourished in the sixth century A.D., wrote Raghuvansa, Kumara Sambhava, Sakuntala and Meghduta. In the seventh century, the novelist Banbhatta wrote Kadambari and Bhartrihari wrote Bhattikavya. Bhavabhuti, the dramatist and poet, wrote Mahabira-Charita and Uttar Ram-Charita in the eighth century A.D. The poet Bararuchi, Sudraka, the author of Mrichhakatika drama, Bharavi, the author of Kiratarjuna, Dandi, the author of Dasakumara Charita, Amarsinha, the great lexicographer of India and author of Amarkosha, Magh, the author of Sisupalbadha, Harsha, the author of Naishadha, Bana, the biographer of Sriharsa and author of Kadambari were a few glorious names of the three brilliant centuries—the sixth, the seventh and the eighth A.D. Commentaries on Smriti or metrical treatises on Law began to be written from the ninth century A.D. and originality in literature gradually declined from this period. During the Mahomedan period compilations from the Smriti works, Grihasutras and the great Puranas began to be written. Madhabacharyya and Raghunandana wrote commentaries on Law at this period.

In administrative and military skill and art the evidences from the two great historic epics—the Ramayana and the Mahabharata—are numerous to prove that the ancient Hindu generals were not inferior to the Grecian or Roman generals in any way. Tod's History of Rajasthana is but a fragment of the

glorious past. Of the five leading fighting races of India the Sikhs, the Gurkhas, the Rajputs, the Mahrattas and the Mahomedans forming the British Indian Army, the first four are all Hindus.

## Indian Theology—its History.

Of the four great religions of the world that had their origin in Asia, namely, Brahmanism, Buddhism, Mahomedanism and Christianity—the first two being the creeds of India arose from the Vedic religion. All the various creeds of India, namely—the ancient Vedic religion or nature worship of thirty-three gods, the dogma of the Smriti and Sanhita, Buddhism and Jainism, the Pauranic religion of thirty-three crores of idol-worship, Saivaism, agnosticism of Sankara, the Tantric creed or mysticism, the Vaishnavism of Chaitanya or the doctrine of devotion, Monotheism, Polytheism and Pantheism all flourished side by side, and have each and all existed to-day. The five kinds of Hindu worshippers that are chiefly found now are (1) the Sun worshipper; (2) the Ganesa worshipper; (3) the Siva worshipper; (4) the Vishnu worshipper and (5) the Tantra or Sakti worshipper of Kali and Durga. At present the worshippers of Rama and Kali are more numerous in the North-West, those of Siva in the Madras Presidency, and those of Krishna, Durga and Kali in Bengal. The worshippers of Vishnu worship Krishna or Rama as incarnation of Vishnu.

During the Vedic period the Hindu Aryans were a compact body without caste distinction. During the Smriti Ages and the Epic Ages of the Ramayana and the Mahabharata the three castes or classes of the Aryans were merely class divisions, allowing inter-

marriages and free education in all the classes. With the new element of the conquered Sudra population there was fusion of the races for a long time. The four primitive class distinctions became in time converted into four hereditary caste divisions under the Manu period. With the succeeding ages of Hindu revival by greater divisions and subdivisions, and by Kulinism, the caste system became very complex, finally losing its numerical strength and significance. The spirit of intoleration and morbid exclusion or selfish independence became more and more marked. Even the cow—the "Gow Mata" was more revered and placed higher above the Sudras in the scale of creation. Individualism gave place to Symbolism and Ritualism, and men were sacrificed for the state and the creed. From this time India did not stand on things but on simulacra or shows of things. Division and disunion were inevitable in a world of insincerity and intoleration. Religions are incessantly being transformed in accord with the environments and the interests of their believers and ministers. Nothing will continue unless the instinct of human progress has a real grasp of the limitations of humanity.

During the Vedic system of Religious Education a man's life was rigidly divided into four stages or *asramas* namely (1) the Brahmacharyya or students' life; (2) the Garhastya or householders' life of married bliss; (2) the Banaprastha or the life of a recluse in forest; and (4) the Yati or the life of a religious mendicant.

Various schools of learning flourished in every Hindu State in the Epic Ages about 1200 B.C. In the religious and social life of this age the Sudras were excluded from the knowledge of the Vedas and other

religious knowledge. The Hindu religions and domestic ceremonies as classified by Gautama fall under forty heads—twenty-one being sacrifices and nineteen domestic ceremonies. The religious customs of the Hindus that are still observed rigidly are (1) *Sradha* in connection with funeral ceremonies; (2) *Annaprasana* or the first rice-taking ceremony; (3) *Upanayana* or the education ceremony; (4) *Marriage* ceremony and (5) the cremation or the ceremony of burning dead bodies.

Thrice in the history of India the Reformers arose and gave religious toleration; in the Gita period of the Epic Age all tenets were tolerated; Buddha and Chaitanya gave religious toleration and tried to remove the fetters of caste during the ages they flourished; Buddhism threw away the whole of the Brahmanical ceremonial with its animal sacrifices, its penances and mortifications and the fetters of the caste system by inculcating religious emancipation based on self culture. With the decline of Buddhism and Jainism there was a Brahmanical revival in the fourth century A.D. Immediately after the loss of their political independence the Brahmans compiled those Smriti works and tried to govern the Hindu society on a more rigid basis even without the sanction of Kshatriya kings. There were four periods of Hindu religious revival: namely (1) the Sruti Age of the monotheistic vedic religions; (2) the Smriti and Sanhita Ages; (3) the Pauranic Age and; (4) the Tantra Age of polytheism. The popular Pauranic religion sprang up about the eighth or ninth century A.D. and idol-worship became prevalent in the shape of Kali and Durga. Greater divisions of castes than four—namely, thirty-six subdivisions of the four castes were formed on more

rigorous principles than ever. Saivaism or the worship of Ṣiva began about 500 B.C. Vaishnavism arose about sixth century after Christ. Both Saivaism and Vaishnavism spread side by side. About the eighth century A. D. Sankaracharyya appeared in Southern India and there was another Hindu revival on the utter downfall of both Buddhism and Jainism Sankara made vigorous efforts to extirpate the Buddhistic Tantric religion into which Buddhism had degenerated about this time. He tried to revive the old Hindu faith under a popular form, preaching Vedanta and Gita to the Brahmans, but to the mass he gave the popular religion and gods of the Puranas namely, the worship of the Trimurti, Brahma, Vishnu and Siva. Ramanuj and Madhava spread Vaishnavism of Krishna.

During the Mahomedan period of the Pathan rule there was religious persecution for a long time by the Pirs and Fakirs, who converted nearly one-third of the Hindus of East Bengal, and nearly one-half of the Rajputs. The Mahomedan rulers were afterwards mindful of their revenue and did not hereafter interfere with Hindu religion. During the Mughal period of Akbar's reign there were friendly feelings and hence there was some fusion of the two races by intermarriages and toleration. But the Mahomedans did not care for the mass education of the Hindus and there was another grand Hindu revival which originated in Bengal in the fifteenth and sixteenth centuries, and the Vaishnab religion of devotion of Krishna spread rapidly. Chaitanya tried to abolish caste by religious emancipation through the preaching of the doctrine of devotion and love. Various Sudra Gossains or preachers became famous during the period. The bar-

ber Madhusudana was a Sanskrit Scholar. Gobinda Karmakar—the blacksmith of Burdwan was a famous writer of his time. Syamananda Gossain—a sudra was well versed in grammar. Narottam Thakur—a Kayastha—Narahari Sarkar also a Kayastha, Parmananda Sen, Jagadananda, Govinda Kabiraj and many other Sudra Gossains had many Brahmin pupils also. Even women were educated at this time. Anandamayee Devi, Gangamayee Devi, and Sundari Devi are a few names.

In Indian History there is only one record of Sudra supremacy under the Nanda Dynasty. Nanda and his eight sons ruled over Magadha from 360 to 320 B.C.

From the Vedic period India was divided into two classes—the Sannyasi class and the Grihastya Brahmins—both of whom have all along fought for the religious supremacy of India. But as soon as the monasteric order obtained wealth and power like the other order they both began to degenerate. The Buddhistic Sramans like the degenerate and despotic papacy of the West degenerated into the later Tantric period.

It is during the British period that a true religious toleration has been allowed and hereditary or acquired religion, whatever it be, is undisturbed, and each man has his own religious beliefs according to his lights. The British Government by a policy of strict non-intervention does not trouble itself to change them. The modern India forms now an *epitome of all the existing religions of the world.* The Islam with its monotheism and pious devotion to the Deity and with its doctrine of universal brotherhood of man has come to stay in India—the land of the Rishis and

Munis—for about one thousand years, and counts sixty-two millions of its votaries in India. With the advent of British Rule Christianity imbued with Lutherianism has appeared in the scene with its doctrine of liberty of thought, freedom and fraternity of man, revolutionizing the whole field of Indian thought. The number of Christian population in India is now about four millions including more than two lacs of Syrian Christians, over ten lacs of Native Protestant Christians and over fifteen lacs of Native Roman Catholic Christians. The *modern Brahmoism or monotheism* of Raja Ram Mohan Roy and Keshab Chandra Sen had its awakening in Christianity and Islamism.

Dr. H. Zeller estimates the religious statistics of the world as follows:—The population of the world is nearly one hundred and fifty-five crores of which more than forty-three crores are Christians, over seventeen crores Mahomedans, more than ten crores Jews, more than twenty-one crores Hindus and more than twelve crores Buddhists.

## The Bengali Literature—its History and Progress before and after the introduction of Printing in India.

For three hundred years during the Mahomedan period, the Pathan Rulers of Bengal encouraged the Bengali Literature. The Ramayana of Kirtibasa composed in the middle of the fifteenth century (1450 A.D.) the Mahabharata of Kasiram Das composed in the latter part of the sixteenth century (about 1600 A.D.), the Vidya-Sundara of Bharat Chandra, the Chandi of Mukunda Ram Kabikankan and various Puranas—such as Padma Purana, Kali Purana,

Durga Purana, and Bhagabat (1473 A.D.) were the great acquisitions to the Bengali Literature of the Mussalman period. The influence of Arabic, Persian and Urdu Literature flowed freely into the Bengali Literature. Many Indians even became as proficient in the Mahomedan languages as the Mahomedans themselves. Apart from Mussalman and unconscious Christian influences, there are numerous visible evidences of permanent Western influences in the Bengali Literature even from the first advent of the Portuguese at Hugli in Bengal. The vocabulary of the Bengali Literature is enriched with words derived from Portuguese, *viz.*:—charuta (cheroot), cadeira (chair), varanda (verandah), almario (almirah), chave (key), toalha (towel), janella (window), padre (missionary priest), camara (room), lanterna (lantern), fita (tape), botam (button), cha (tea), cafe (coffee), tijella (bowl), pirish (saucer), sabao (soap). The Bandel Church on the Hugli is a surviving monument of the Portuguese influence in Bengal.

The origin of the Bengali alphabet is first mentioned in the Kamdhenu Tantra. The Gita Govinda of Joydeva was composed in the seventh century A.D. Vidyapati and Chandidas and the vast Vaishnava literature of the Chaitanya period were valuable acquisitions to the Bengali Literature in the fifteenth and sixteenth centuries. Krishnadas Kaviraj wrote his Ragamoyeekana in the sixteenth century. Kamini Kumar, Brindaban Lila and Bhasâ Parichhed were written in the eighteenth century.

With the advent of the art of printing in India in the nineteenth century and with the establishment of the Calcutta Fort William College in 1800 the following books were written for the civilians:—Rajabali and

Battrish Singhasan by Mrityunjaya Tarkalankar, Krishna Chandra Charita by Rajib Lochan Mukerjee, Protapaditya Charita and Lipimala by Ram Ram Bose, Tota-Kahini by Chandi Charan Munshi and Purushpariksha by Hara Prosad Kar.

With the progress of English education and by the union of the Eastern and Western culture, the Bengali Literature was greatly embellished in the nineteenth century by a galaxy of famous authors and editors such as Raja Ram Mohan Roy, Iswar Chandra Gupta, Akshoy Kumar Datta, Pundit Iswar Chandra Vidyasagara—the great social reformer of Bengal—Dina Bandhu Mitra, Peary Charan Sarkar, Peary Chand Mitra and Bankim Chandra Chatterji followed by four great poets of Bengal—Michael Madhu Soodan Datta, Hem Chandra Banerjee, Nobin Chandra Sen and Robindra Nath Tagore. Female authors and poets of this period are Srimati Kamini Roy, Sarnakumari Devi, Girindra Mohini and Mankumari.

## Western Education—its History and Results in Arts, Sciences, Law, Medicine and Engineering.

David Hare started the Hare School in Calcutta in 1816, and the Hindu College was established there in 1817. The Junior and Senior Scholarship Examination system was introduced at this time. The General Assembly's Institution was started by Reverend Alexander Duff of the Scottish Church in 1830. In 1835 through the memorable exertion of Lord Macaulay—the first Law Member—the Governor General Lord William Bentinck adopted English as

the medium of imparting Western Education—whether literary, scientific, technical and artistic—in spite of a great party of opposition for the Oriental and the Vernacular method of education. Lord Macaulay had largely at heart the introduction of scientific and technical education as the most useful knowledge, through the medium of English in place of the classical or the vernacular.

The philanthropic Subarnabaniks of Bengal that helped Lord Clive and Warren Hastings with their finance did much for the spread of English Education in Bengal. Raja Baidya Nath Roy Bahadur contributed fifty thousand rupees to the first Hindu College of Calcutta. Gour Mohan Addy was a pioneer of spreading cheap English Education and founded the Oriental Seminary in 1829. The Seal's Free College was founded by the munificent gift of one lac of rupees by Mutty Lal Seal in 1843. Maharajah Durga Charan Law *founded scholarships in* the Calcutta Presidency College by a princely gift of rupees fifty thousand. The Parsi philanthropist Premchand Roychand made a munificent donation of two lacs of rupees to the Calcutta University in 1866.

For imparting medical knowledge and the laws of Public Hygiene and Sanitation, the Calcutta Medical College was founded in the year 1835 by Lord William Bentinck. So great was the disinclination for dissecting the dead bodies that not a single Brahmin student took admission into the College. It was through the exertion of David Hare that Madhu Sudan Gupta—the first Hindu—dissected the dead body, and guns were fired to commemorate the occasion. In 1836 the Hugli College and the Madrasa of Muhammad Mohsin were founded at Chinsurah by his

munificent gift of nine lacs of rupees in the cause of education. In 1849 female education was first introduced into India by Mr. J. E. Drinkwater Bethune, and the Bethune College was started and maintained from his private funds until 1851, and the Most Noble Marquis of Dalhousie bore all its expenses from 1851 to 1856. It has since been taken by the Government of Bengal.

Sir E. Wood's famous Educational Despatch—the greatest intellectual Charter of India—was passed in the year 1854 leading to the establishment of Indian Universities in every Presidency towns about 1857 during the administration of Lord Canning. There are five Indian Universities teaching Western Arts and Sciences and situated in Calcutta, Bombay, Madras, Lahore and Allahabad. The first three were founded in the year 1857, the Lahore University was founded in 1882, and the Allahabad University in 1887. The Indian Universities confer degrees in Arts and Science, Engineering, Medicine and Law which are the four professions that are open to the educated Indians by which the educated class earn their livelihood in Government service and elsewhere.

*Medical Colleges* have also been established at Madras, Bombay and Lahore. There are twenty-two Government Medical Schools. Hospitals, dispensaries and lunatic asylums have been provided for the sick and poor people. In 1902 there were two thousand and four hundred public hospitals and dispensaries in British India. There were two hundred and sixty female hospitals, which were first inaugurated by the Countess of Dufferin in 1885. There are also one thousand hospitals and dispensaries in the Native States. The *Indian Pasteur Institute* at Kasauli has been started

for medical research work. *The Government X-Rays Institute* at Dehra Dun was established in 1905.

Legal Education is given in Central Law Colleges at Madras, Bombay, Lahore, Calcutta and Allahabad. The Calcutta *University Law College* was established in 1908.

Industrial Schools of Arts were also founded at Calcutta in 1854, at Madras in 1850, at Bombay in 1857 and at Lahore.

Engineering Colleges have been founded at Sibpur, Roorky, Madras and Bombay.

Agricultural Colleges have also been established in Madras, Bombay, United Provinces and the Central Provinces.

Special schools for the education of low-caste children have also been provided, and even Chief's Colleges at Ajmere, Rajkot, and Lahore have been established by the Indian Government.

The Deaf and Dumb School has also been started in Calcutta for teaching deaf and dumb boys.

Schools for the blind and Reformatory Schools for defective children have also been established in different parts of India.

Libraries and Museums have been established for the purpose of promoting learning and encouraging research. The true university of these days, according to Carlyle, is a collection of books.

The Imperial Library and the Metcalfe Hall was founded in Calcutta.

The Calcutta University Library founded in 1874 with a capital of Rs. 9,000 has been named after the Maharajah of Durbhanga, who made a munificent gift of rupees two-and-a-half lacs in 1908. Good libraries are also attached to many Government Colleges.

The Vernaculars of the country have also been encouraged by the establishment of Primary Schools.

*Oriental or classical learning.*—The British administration has had to do every thing for the people and the vernacular and classical languages have not suffered in any way, but have been largely patronised and cultivated by awards of stipends. Colleges and schools for the cultivation of oriental and classical literature, philosophy and religion have been established by the Government, mainly through the efforts of Warren Hastings and Oriental scholars, such as Sir William Jones and Colebrook.

The Calcutta Madrasa was established in 1782, the Benares Sanskrit College in 1791, the Poona Sanskrit College in 1821. The Calcutta Sanskrit College was founded by Lord Amherst in 1824 where Hindus of all castes are now admitted. The Agra Sanskrit College was established in 1823 and the Delhi College in 1825.

There are more than one-and-half lacs of *Educational Institutions* in India with nearly half crore of scholars as mentioned in the statistics of British India in 1908-09. Of these there are 5,200,035 male scholars and 784,075 female scholars. Of the total number of scholars 4,278,326 males and 693,287 females are in primary schools and 919,306 males and 90,227 females are in secondary schools and colleges, the college students numbering about 26,000. The total *expenditure* on education amounts to Rs. 6,58,00,000 of which 54 per cent. is met by taxation and 26 per cent. from fees and the balance by subscriptions and endowments.

The results of the *University Examinations* show that in 1908-09 Hindus 1,555, Mahomedans 144, Christians 96 and Parsis 83 passed the B. A. Exam-

ination, and in the B. L. Examination Hindus 639, Mahomedans 29, Native Christians 8 and Parsis 18 came out successful.

The *Asiatic Society of Bengal* was founded in imitation of the Royal Society of London by Sir William Jones, the Chief Justice of the Supreme Court of Calcutta, in the year 1783. This is a research institution devoted to the ancient classical and oriental works containing the treasures of wisdom of the glorious East hidden in the bosom of centuries, with a view to the advancement of knowledge by a study of the past in the field of Indian history, philosophy, antiquities and science.

The *Indian Museum* first started by the Asiatic Society in 1814 and the Asiatic Society of Bengal have been located at 57, Park Street, Calcutta, since 1876.

Other *Economic Museums* have been established at Lucknow, Bombay and at Dehra Dun. James Prinsep was the first Oriental Scholar, who successfully deciphered the Edicts of Asoka, the great Buddhist Emperor of ancient India about 250 B.C. Horace Hayman, Wilson, Sir William Jones and Colebrook were the great scholars who started researches in Indian antiquities.

The *Survey of India Department* is a Government research institution in pure science and includes the trigonometrical, magnetic, meteorological, topographical and revenue surveys as also marine survey, geological survey, botanical survey and the archæological survey of India.

It is for the first time in the history of India that, after two thousand years of physical, mental and moral torpor, the boon of *state education* for all India without distinction of caste, creed and colour, the

freedom of speech and thought within the bounds of law and the freedom of belief have been conferred on the people of India under a benign Christian Government and that to be born in the twentieth century *under the British rule* with all its drawbacks is a boon for which the Indians can never be sufficiently thankful.

For more than three thousand years of the racial see-saw of the past the arrested world of the sentient Sudra or Pariah intellect was "cast as rubbish to the void" and now for the first time in the history of the world, thanks to *the results of British Rule and British Education* in India, the Sudra intellect or brain under the natural stimulus of use and in accordance with the prophetic vision of Lord Macaulay has asserted its time and place value in the economy of nature in spite of the morbid distinctions of race, religion and social position. It is by a singular irony of fate that when Asia drowned itself into ignorance, Europe stepped out and that the knowledge which Europe received as heritage from the older civilizations of the East by the laborious land route, flows back again into India and the East by the greater sea-route encompassing both the East and the West. If brooks made the differences in the past isolating the races, oceans unite them now forming the East and the West one island continent governed by international arbitration and unification of laws for the common welfare of humanity, though obstinate tradition, selfishness and cupidity of man ever shriek against this creed of "peace on earth and good will towards men." To-day there has been established a literary, intellectual and material commerce between Great Britain and modern India. Baron Napier, nearly forty years ago, foretold the following four points that would be achieved in

India by Western Education, namely, (1) a new basis of national unity; (2) a rational knowledge of the institutions of the East; (3) self-government; and (4) participation in the general intellectual movements of the world, now and hereafter.

The English language is already the language of all educated Indians for political, commercial and educational purposes. In Madras, English is spoken even by the coolies in the street. In Bengal, English has become a unique vehicle for the spread of national ideas whether from the press, the platform or the pulpit. In Bombay, English has become the common language of immense business and commercial transactions. The United Provinces and the Punjab are rapidly taking to English as a means of communication with the rest of India and in no province has the vernacular suffered in any way. The elementary knowledge of the three R's is imparted to the children through their own vernacular tongues.

The English language and the common Western system of education, easy means of communication in land and water by the rail and the steamer, the cheap postal system, one common Penal Code and Law, one common Government and the Printing Press,—the universal wireless message of mankind—have each and all, like surgical ligatures or skin grafts, contributed to the fusion of the various races and creeds of India by developing common ideas and interests, sympathies and aspirations on a *common political platform.*

The unflinching Pathan, the brave and royal Moghal, the chivalrous Rajput, the hardy and intelligent Mahratta, the martial Sikh, the valiant and faithful Gurkha—the "Green Jacket" of the East, the

enterprising and philanthropic Parsi and the intellectual and persevering Bengali—peoples of all creed and colour—despite the want of unifying inspirations of a common religion or race, can now meet and shake hands with one another as friends and neighbours in the common arena of civilization under the most benign British rule. Whatever national progress has been made in India in modern times is the *work of British energy and the influence of Western education.* No form of unity in a nation, whether from within or from without, can be self-perpetuating, for by the law of growth and decay it is ever liable to break down by internal decay or by attack from without. It is only by the strength of righteousness and improvement invigorating the ever progressive conscience that the perpetuity and constant advancement of humanity within its limitations are secured and maintained.

## The Civic Rights and Government Service—as the Results of British Education and the Political Status of the Modern Indians.

Thanks to Pax Britannica to-day India enjoys the blessings of peace throughout the length and breadth of the country after centuries of intestine wars and foreign invasions. The three principal factors that maintain the external and internal peace of a country are its armies, navies and the police. In 1900 the total strength of the army—the instrument of the Pax Britannica—in India was two hundred and twenty-three thousand including seventy-six thousand

British garrison. In 1904 the permanent peace expense per head of the population was one anna and four pies for the army and two pies for the police per month. The civic rights of the natives of India are as large as those of the Englishmen. The highest civil appointments of the Indian Civil Service are thrown open to public competition. Despite human short-comings the English rule has taken the initiative in every field of political, social and economic problems of India. Fifty years ago there were no Indians on the bench of any Supreme or Chief Court, in the Legislative Councils, or in the Civil Service. To-day the Indians are freely admitted on the bench of the Supreme Courts, in the Legislative Councils, or in the Indian Civil Service, eleven Indians occupy the seats in the four High Courts in Bengal Madras, Bombay and Allahabad, and four are Judges in the Chief Courts at Lahore, Rangoon and elsewhere. Out of twelve hundred Civil Servants sixty-five Indians are in the *Indian Civil Service.* Out of a total of three thousand seven hundred there are over three thousand six hundred native Subordinate Judges and Munsiffs and Magistrates in the Provincial and Subordinate Civil Services. Recently a Bengali gentleman was appointed a Member of the Board of Revenue. Two Indian gentlemen are now sitting as Member of the Council of the Secretary of State. Three Indians have been appointed to the Executive Councils of the Viceroy and of the Governors of Bombay and Madras. One Indian gentleman has been appointed to the King's Privy Council.

The Indian Medical Service—the highest branch of medical service in India—is also open to the natives of India. The Civil Assistant Surgeons and Sub-

Assistant Surgeons are mostly natives of India. The Provincial Engineers, Subordinate Engineers and Supervisers are recruited from the Indian Engineering Colleges. The English Bar has always been open to the natives of India.

The system of election by municipal rate-payers was established in Bombay in 1872, in Calcutta in 1876 and in Madras in 1878. The principle of Local Self-Government was greatly extended by Lord Ripon in 1882. Urban affairs are to-day, therefore, in the hands of Local Bodies in every province, elected or nominated, under the Local Self-Government Acts from the seven hundred and fifty-seven municipal towns with a population of about sixteen lacs. There are eighteen hundred District Boards in all with thirteen thousand non-official members. The District Boards of Bengal number about thirty-eight with their nine thousand and eight hundred members all of whom are natives. The various Legislative Councils elect their non-official members through the University, Chamber of Commerce, District Board and Municipal Corporation. There are also three thousand Honorary Magistrates or Justices of the Peace in India. Their powers are as extensive as those of English Justices and they are a very substantial force in the public life of the community. Birth-day honours, titles of personal distinctions, certificates of merits and medals are freely awarded by the Governor-General in Council to persons of public fame and meritorious service. The Reformed Councils Act passed by Lord Minto's Government is considered as a political renaissance of India giving enlarged councils, both Imperial and Provincial, and enlisting the co-operation of the land-holding and

commercial classes as well as of the Journalists and Lawyers. Mr. S. P. Sinha was the first Indian Colleague of the Viceroy as his Law Member Mr. Ali Imam is the next Muhammadan Law Member of the Viceroy.

## The Technical Education in Europe.

Seeing the success and rapid expansion of technical schools and colleges in Germany, France and the United States, England also introduced the technical system of education in the United Kingdom in 1874. There are eleven technical colleges and over thirty-five schools for technical education in London. Various technical schools and colleges have been founded at Bradford, Birmingham, Brighton, Bristol, Derby, Northampton, Manchester, Leeds and Glasgow in all of which more than three crores of rupees are spent for technical education in England.

In the Continent the statistics of 1905 shows that:—

In Austria there are one hundred and forty-four technical schools, two hundred and forty commercial schools, and one hundred and twelve agricultural schools.

In Belgium there are two hundred and twenty-two technical and eight agricultural schools.

In Holland there are hundred technical schools.

In Italy there are nineteen marine schools and two colleges in mines.

In Russia there are fifty-three commercial, seventy technical and nineteen agricultural schools.

In Switzerland there are three hundred technical and seventy-two commercial schools.

# The Technical Education in India.

Agriculture is the main and exclusive occupation of more than eighty per cent. of the people of India. There is no harmonious co-ordination or balance between agriculture and industrial occupations. Agriculture is mostly unscientific and dependent on capricious rainfall, and hence famine is the natural outcome on occasions of drought. Even exclusive dependence on agriculture dulls a nation's intellectual advancement. Moreover a purely agricultural people cannot support a nation in the movements and magnificence of the modern industrial civilization. If scientific agriculture is adopted in India all food crops can be raised fifty per cent. more than at present and that, if attained, would help to banish scarcity and famine from the land. India was from time immemorial the home of the four typical products, *viz.*, the cotton plant, the sugar-cane, the silk and the indigo all of which were once her monopolies. Indian cotton is not so valuable as Sea Island, Egyptian, Brazilian and American, the staple not being so regular in length. To-day Indian cotton does not yield hundred lbs. of cotton lint per acre, being less than one-fourth of the average produce of Egyptian cotton fields. Even an acre of sugar-cane does not yield as much as a ton. In the West Indies the average produce is nearly three tons. As regards raw silk, the Indian silk in ancient time had a universal reputation. To-day the world's supply of raw silk is derived mainly from China and Japan, from Italy and France, and India is hardly a competitor in the world's market. In silk manufacture, France claims to have about one-third of the silk trade of the world valued at 12 crores

of rupees. As for indigo, it is replaced by the chemical indigo of the German laboratories. As regards sugar, India no longer sells but buys 10 crores worth annually.

*Agricultural Colleges* have been established in Madras, Bombay, the United Provinces and the Central Provinces to train up farmers for all forms of agriculture and to teach them how to protect cattle and plants from diseases and the ravages of insects. A Central Agricultural College for the whole of India has been founded by the Government at Pusa in Behar. There is also an Agricultural College at Sabour in Bhagalpur in 1910.

*Model farms* have been established in all the provinces—at Sibpur, Burdwan, Chinsurah, Dumraon, Saidapet, Khandesh, Nagpur and Cawnpur as also at Sabour, Cuttack, Bankipore, Kharagpur and Ranchi.

The Indian Government has taken the initiative in every field of Technical Education of the people to train them as engineers, farmers and artisans. Technical Education embraces all kinds of instructions in science, art, technology and manual training that have direct reference to qualify a person for some branch of productive industry. Students have been sent to America to receive agricultural training at the Corneil University.

*Engineering Colleges* have been founded at Sibpur, Roorky and at Madras and Bombay to teach civil and mechanical engineering. In Bengal the Engineering College was established at Calcutta in the year 1856, and was removed to Sibpur in the year 1880, where civil, mechanical, electric and mining engineering are now taught. There is also an Engineering College at Poona. *The Victoria Jubilee Technical Institution*

was founded in Bombay in 1887. In 1902, there were about 123 *Industrial Schools* in India. *Survey Schools* have also been opened at Hugli, Dacca, Patna and Cuttack. There are Technical Schools at Midnapore, Mymensingh, Dacca, Rajshahi and Rungpur to train artisans for the workshop, factory and the mill. At Serampore there is a Government Weaving and Spinning School. There is also the Hewett Weaving and Spinning School at Bara Banki in the U.P.

*Professor T. K. Gajjar's Techno-Chemical Laboratory* in Bombay was started in the year 1899. It has greatly helped the introduction of *Dyeing Industry* in India. The *Bengal Technical Institute* of Calcutta was established in 1906 by the munificent gift of Mr. T. Palit and others.

The *Indian Institute of Science* at Bangalore devoted to original research work has been founded by the munificent gift of the Parsi philanthropist Mr. J. N. Tata. It has an income of more than 2½ lacs of Rupees per annum for its research work in pure science and ten lacs of Rupees has been invested for the erection of its buildings.

THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE was started at Calcutta by Dr. Mohendro Lal Sirkar in the year 1876 with a subscribed capital of 2½ lacs of Rupees.

THE ASSOCIATION FOR THE ADVANCEMENT OF SCIENTIFIC AND INDUSTRIAL EDUCATION OF INDIANS has been established in Calcutta in the year 1904. The Association grants scholarships and free passages to Indian students for industrial education in foreign countries.

# The History of Famines in Modern India—their Remedy and Prevention.

Famines have always visited India from pre-British days, brought on chiefly by drought as well as by flood, by blight, by locusts or by war, and are also mentioned in the great epics of the Ramayana and the Mahabharata. In India periodical famines occur on periodical failure of the rains. The history of famine in modern India will show its frequency from the following:—

1. The Great Bengal Famine of 1769-1770 in which more than one crore of people or rather one-third of the whole population of Bengal died.
2. The Karnatic Famine of 1780-1783 during which period the Government of Warren Hastings established grain golas or granaries with a view to giving speedy relief in time of actual outbreak.
3. The Madras Famine of 1790-1792 and five others up to 1854.
4. The Great Famine of North India in 1837-1838.
5. The North-West Famine of 1861, and the Rajputana Famine in 1868-1870.
6. The Great Orissa Famine of 1865-1866 in which about a quarter of the population died.
7. The Behar Famine of 1873-1874 when the Government of Lord Northbrook spent seven crores of rupees and completely checked it without loss of life.
8. The South Indian Famine of 1876 in which the Government of Lord Lytton spent sixteen crores of rupees.
9. The Great Famine of 1896-1897 during Lord Elgin's time.

10. The Great Famine of 1899-1900, in which the Government of Lord Curzon spent seventy-five crores of rupees in Relief Works.

11. The Famine of 1905-1909 throughout India due to extensive failure of crops.

*The Remedy and Prevention of Famine.*—They may be best secured by *irrigation* for raising the crops, by *railways* for distribution of food and by *Co-operative Credit Banks* to help the ryots to borrow money at a cheap rate of interest. The diversification of the *industrial occupations* for the people can alone bring the industrial salvation of India, and will thus give them larger opportunities to secure their political advancement as an individual or as a nation. India needs more of educational and moral, social, industrial and material progress than of political ambition or racial ascendency. A people poor and weak in political economy shall be necessarily effeminate in body politic, and one cannot expect to build the chambers of the upper story of his house of politics before he has laid the foundation walls of his political economy on a sound basis, for it would be as futile as the attempt of a child to spurn its toys and cry for the moon. Without ignoring the value of political reforms His Honour Sir John Hewett, Lieutenant Governor of U. P., while opening the Industrial and Agricultural Exhibition of the United Provinces at Allahabad on 1st December 1910 rightly observed that "in the present stage of civilization in India political questions are as nothing compared to economic ones. Politics in the present state of Education can only interest the very few. What is required in India is Industrial progress."

To-day scientific knowledge and skilled intelligence

have become the mistress of the industrial globe and only intelligent people will be victorious in the struggle of industrialism. It is by resolute industrial enterprise that the "nation of shop-keepers" of that great "land of common sense" has to-day become a "nation of world-governors." To-day technical education is the principal magistrate of man's life in the industrial supremacy of a nation. India in her industrial race should not forget the lesson of the sleeping hare and the plodding tortoise. Her vast external trade is "passive" and due to the enterprise and activities of outside merchants. It is equally true of India, according to Lord Mac Donnell, that "agriculture is carried on by methods which prevailed three thousand years ago, where arts and trades are stagnant, where there is no inventiveness and where the mineral wealth of the country is neglected unless where European enterprise has developed it." If India has no "active" commerce of her own, it is because she chose to play the sleeping hare in the game of commerce, depending upon external causes and outward accidents for her fortune Great Britain possesses about twenty-thousand vessels in her merchant navy including about ten thousand steamships manned by more than two lacs of men; more than three thousand vessels pass through every year by the Suez-Canal to India, two-thirds of which are British. In short, all the main currents of commerce on the globe pass through Great Britain.

The *Railways* have conferred incalculable benefits on India as a cheap means of transport and travel. Indian commerce in its present development is very largely the product of the Indian Railways. The Railway service affords employment to 525,000 per

sons of whom 508,000 are natives of India. The total mileage of Indian Railways open for traffic is more than 30,000 miles. India has had to pay heavily for the blessings of peace from the advantage of the iron road, which is the most powerful agent of political power and human solidarity. Agriculture has vastly expanded by the stimulus imparted by Railways in distributing the food supply. Indian Government has been paying interest to English investors for their capital on the Railway and the loss involved amounts to three crores of rupees annually. But the Railways are a sound financial investment and have already proved to be amongst the sources of revenue to the Government since 1900. The net earnings of the Indian Railways in 1908 amounted to 4·33 per cent. on £274,000,000 invested by Government on the Railways.

*Irrigation Works.*—Perennial irrigation works by tapping a river by gravitation existed in ancient India but were of a Lilliputian kind. The two other older methods that are still preserved to irrigate cultivating grounds are drawing water (1) from a tank or a stream by means of buckets swung to and fro by a couple of men catching the water on the upstroke or by means of canoes made of palm-trunk, and (2) from a well or reservoir by means of long pole buckets or leathern jars worked by man power or bullock power—the two laborious lifting methods that have been used also in ancient Egypt and in China. There are about one hundred and forty Indian Irrigation canals opened by Government, which are to-day a source of unfailing granary yielding sixty to seventy crores of rupees worth of crops annually. Irrigation combined with scientific agriculture assures, improves and vastly enhances the pro-

duce of the field. Power means fertility and wealth in disguise, and manure in future will mean electricity for fixing the nitrogen of the atmosphere. The cost of irrigation works amounted to forty-five crores of rupees to the Government, and the return to-day averages about seven per cent. per annum on the capital invested. According to Sir Colin Scott Moncrieff twenty per cent. of the total cultivable area of British India and ten per cent. in the Native States are annually irrigated, or in other words taking the country as a whole, one acre in every seven is irrigated. To supplement the natural rainfall at least thirty-three per cent. of the cultivable area should be irrigated in order to provide against future famines.

The total area of cultivated land in India is about 226,000,000 acres. Of these 13,000,000 acres are irrigated with great labour by means of primitive water-lifting appliances from nearly two million *wells*, 18,000,000 acres from *canals*, 8,000 000 acres from *tanks* and 6,000,000 acres in various other ways. Only 17,000,000 acres of land are watered by Government Irrigation Canals fed by rivers, and the remaining 3,000,000 acres by old native canals improved, extended and maintained by Government. The Indian Irrigation Commission of 1901-03 estimated that only six per cent. of the gross Indian rainfall was utilized for artificial irrigation, thirty-five per cent. flows uselessly to the sea by means of rivers, and the remainder fifty-nine per cent. is either evaporated from or absorbed by the soil or utilized in sustaining plant life.

Sind and Bombay are watered by artificial inundation canals filled by flood. The Punjab and the United Provinces are irrigated by *wells* nourished by sub-soil water. The Deccan is irrigated by *tanks* and

*reservoirs* fed by surface drainage. Lower Bengal and Oudh are visited by *natural inundation.*

The *Upper Ganges Canal* was opened in 1842-1854, and the Lower Ganges Canal in 1866.

The annual value of crops irrigated by the two Ganges Canals of the United Provinces is about four crores of rupees.

There are also *three Jumna Canals* in the United Provinces. During the Mahomedan period the first Jumna Canal known as the Western Jumna Canal was constructed by Firoz Shah. In *Bengal* there are the Sone Canals in Behar and the Orissa-Mahanadi Irrigation Canals. The Sirhind Canal, the Chenub Canal opened in 1887, the Jhelum Canal opened in 1901, the Bari Doab Canal and the Western Jumna Canal are in the *Punjab.* In the *Madras* Presidency anicuts or bunds have been built across the deltas of the Godavery Krishna and Kavery where eight-and-a-half lacs of acres of land are irrigated, yielding about one crore of rupees of crops annually.

*Co-operative Credit Banks* have been established to save the Indian ryot from the clutches of money-lending "Shylocks," in imitation of Co-operative Loan Societies introduced in Europe by the efforts of Raffheisen and other reformers, which have revolutionized the life of the peasant farmers of Germany, Italy and France. In India the system was first introduced by Mr. H. Dupereux, I.C.S., of the United Provinces, during Lord Curzon's Viceroyalty. The Co-operative Credit Societies' Act was passed in India in 1904. In 1908-1909, there were already two thousand Co-operative Credit Societies with a capital amounting to nearly eighty lacs of rupees and with 185,000 members.

## The History of the Factory System—its Capital and Wages.

Standing on the threshold of the twentieth century, when we look back we find the age of machinery and mechanical power and the era of intelligence, prosperity and general development began from 1760 or the latter half of the eighteenth century, replacing the old hand-production with the manual tools, worked by the combined monotonous labour of man and beast. Thus the ancient irksome physical labour and drudgery of man and his manual tools are replaced by his intellectual or ocular labour and by his machines, which strengthen his feeble hands with "the force of all the elements" in the modern Scientific Factory System. To-day man earns his bread not by the visible sweat of his brow but by the invisible sweat of his brains.

Hargreaves, Crompton, Arkwright, Cartwright, Whitney and Watt are the fathers of the modern Factory System of Textile Industry—the oldest of all the living arts. Their radical inventions hanging between heaven and earth have " killed " the hand-loom weaving in England as much as they did in India. The letters patent for invention was first granted in England in the reign of James I. about the year 1617 A.D. In America the letters patent, although enacted in 1790, was not adopted until 1836 in the United States in its present form. During the middle ages the fetters upon foreign commerce were first relaxed in England in 1303 by the era-marking enactment of the *Carta Mercatoria*—the magna charta of commerce passed by King Edward I. In 1361 the exportation of corns from England was forbidden,

and in 1467 its importation was prohibited, and not till 1846 were the Corn Laws swept away and the ports of England thrown open to the free entrance of food. England's commercial history begins from the Elizabethan period, when enterprises were fostered by Royal monopolies. In 1624 the glaring monopolies were generally abolished as the pernicious system of protection—"the canker of all trading"—increased the prices of commodities; salt for instance, from 1s. 4*d*. a bushel went up to 14*s*. Even Queen Elizabeth could not take the right view to encourage the important invention of the stocking frame by the Rev. William Lee, which in after years was to give rise to the great stocking-weaving industry of Nottingham, Leicester and Derby. In 1807 the abolition of slave trade took place in England. The free-trade agitation against the removal of trade restrictions due to "Protection" and "Prohibition" began in England about 1820. Thanks to Richard Cobden's Anti-Corn-Law-Crusade, Sir R. Peel removed the protective restrictions which clogged the wheels of trade, in 1846. The whole system of protection was dropped, and Great Britain stood alone among the nations of the world as a self-reliant free-trading nation. In 1847 the Factory Act to restrict the day's labour into ten hours was passed in England. The boon of the Limited Liability Act was passed in England in 1862. Germany, France, Austria and the United States soon followed the British Factory Acts of 1878. The factory system which had its birth place in England spread gradually to France, Belgium, Germany and finally to America. To-day the textile factory forms a golden chain round the world, and it is the locomotive that has broken

down all the selfish and natural barriers of internal commerce.

Mankind has progressed all through the three divisions of history—ancient, mediæval and modern ages, and passing successively through the stone age, the bronze age and the iron or coal age with their various systems of labour—the slave system, the feudal system and the wage system. Thus brute force, bravery, material wealth and intelligence have each in its turn been the dominant factor in the evolution of human progress as is vouchsafed within the limitations of humanity.

In the United States of America although the Republic was founded in 1789 A.D., very few patents were issued in the early days of the Republic before 1836. The patent system was in full operation about 1845 when only 3,873 patents were issued, which by 1895 assumed the formidable number of 531,619. *Women inventors* are also competing with men in every line of industry, and are making large Royalties upon their simple inventions. The world-renowned element of radium was discovered by the French woman Physicist—Madame Curie—in 1898. Many eminent women of different countries have adorned the annals of science and scientific research : Madame Flammarion—the French astronomer, Mrs. Ayrton—the electrician, and the only woman member of the Institution of Electrical Engineers of London—Miss Ormerod—the entomologist, Madame Sara Bernhardt, Mary Somerville, Caroline Herschel, Miss Agnes Clerke, Miss Elizabeth Brown, Madame Jurin and Madame Merian are a few names. By the influence of machinery alone more than three hundred occupations are open to women. To-day women are

freely admitted into the ranks of the medical profession. The modern women are making their mark in journalism, medicine, nursing, science, literature, art, music, teaching and philanthropy. The sewing machine alone gives employment to two crores of women in the world. The steel pen industry gives employment to eight thousand women in England and in America. Some of the brilliant women of business—Mrs. Oelrichs, Mrs. Hettie Green, Mrs. Richard King, Mrs. N. Collins, Mrs. Rochette, Senora Cousino and Mrs. Rawles Reader—are mentioned in the "Road to Riches" by Thornton Hall.

Before the advent of the nineteenth century, invention or original thought was synonymous with the black art or witch-craft. The introduction of umbrella in England by Mr. Jonas Hanway, who first carried an Eastern umbrella from China to London in 1750 A.D., is an example which shows that much moral courage is even needed for such little innovations, for which he was hissed and hooted and pelted by every passer-by. The umbrella is now a necessary article of everyday use in Europe

The patent laws of all the civilized countries of the modern time reward an inventor by the monopoly of letters patent, and regard him as a public benefactor whose hidden light helps and blesses mankind. "Man is by nature a political being" was the famous saying of Aristotle, so political economy is the birthright of man. The right to live as long as life is vouchsafed by nature, the instinct of self-preservation, the natural right to liberty of action and thought without infringing a like right in others, the right of property, and the right of exercising one's intelligence over all matters which interest one without persecu-

tion—all give the freest scope and opportunity for the exercise of individual effort and talent, and protect the individual from being used as an instrument for the power and benefit of another, since every human being is an end in himself.

In this ocular age manual labour is replaced by visual labour, working through the light of knowledge and the mastery of mind over matter, in the Factory System of Industry. The physical or much-maligned so-called materialistic age of the world, like a silk-worm is constantly transmuting the genius of money into mind by means of machine—which is more than a book—the living embodiment of his thought. To-day mankind as intellectual monopolist, individually or collectively, has become in this spiritual or rational age the "monarch of all he surveys."

The progress of inventions and discoveries of science, as much as the philanthropy of capitalists, is working hand in hand with the aims of social justice by breaking the monopoly or the tyranny of monster capitalists, having a tendency to engulf the factory system by pitiless exploitation of labour. The perception of utility and efficiency and enlightened self-interest minister to a well-ordered social condition where the duty and interest of both the employers and labourers coincide. Economic problems are thus solved by the efficiency of economic means. The enemy of industry is not the tyranny of capital, the aggressive tariff, the economy of large scale operations or the business intrigue, but the formidable engine of Applied Science which like a wolf does not count for the numerical strength of the sheep. The system of co-ordination in industry has attained its zenith in Germany, and the spirit of ap-

plied science is equally manifest to-day in France, in England, in Italy, in America and in Japan. The value of a trained chemist and a research laboratory attached to every industry is nowhere so zealously recognized as in Germany. In England about 1864 the *silk waste industry* was perfected by Lord Masham then Mr. C. S. Lister, of Bradford, after years of patient labour and the expenditure of £360,000. The Alpaca trade using the silky fibres derived from the Angora and Thibetan goats is primarily the result of enterprise, ingenuity and investigations of the late Sir Titus Salt. The Alpaca, spun or waste silk and jute are a few examples in which British manufacturers have taken the initiative. Rags and tatters picked up in every quarter of the habitable globe are shipped to London and conveyed to Yorkshire to be reduced to filaments, then made into yarn, and converted into new wearable fabrics. By 1860 the manufacture of this branch of woollen cloth from rags known as *shoddy trade* also became a successful industry in England. The *waste products of various industries*—such as hydrochloric acid from the soda industry of the alkali works; glycerine from the soap industry; artificial indigo, carbolic acid, napthaline, benzine, ammonium sulphate, and numerous other products from the coal tar industry; vaseline and paraffin wax from the petroleum industry—are to-day turned into highly remunerative commercial products. Those who would like to know more on the subject may consult Koller's "Utilisation of Waste Products" and P. L. Simmond's "Waste Products and undeveloped Substances." More than 500,000 tons of ammonium sulphate valued at six crores of rupees is recovered annually from the coal tar industry, and is used as an

agricultural manure. The Norwegian water-power factory at Nottodden is manufacturing 5,000 tons of nitrate, since May 1905 by fixing the inert and hitherto useless atmospheric nitrogen, and is expected to supplant the natural Chili saltpetre which is now annually produced to the value of eight crores of rupees. By the "contact process" of the catalytic action of platinum, Germany manufactures 200,000 tons of sulphuric acid annually, and is a formidable rival of the older "Lead Chamber Process," by which England produces 3,000 tons of sulphuric acid every day. Since Germany freed alcohol to industry in 1891, it is now produced from cellulose direct by catalytic fermentation, and is becoming an universal source of new power and fuel. The blessings of industrial alcohol have already borne its fruits in Germany where more than 6,000 alcohol engines are in use. France and the United States have followed suit by removing duty on industrial alcohol; yet it is curious to see that like France, Germany which first freed alcohol to industry and the United States which does not tax the patents at all, both profess to be protectionists, raising an international tariff wall and believing protection to be sun-shine and irrigation to their industrialism, and the Vena Porta to their national wealth, and, like Æsop's damsel, cannot forego the temptation of imposing the so-called "discriminative duties" on goods imported from foreign countries in favour of their home products. History repeats itself. Thus the selfish monopolizing spirit of capitalistic forces of modern society, is eager to exploit the tax system for their benefit, through the so-called pecuniary sacrifices of the country's government, by resorting to *indirect taxation* to meet the financial needs of the country.

It is worthy of note that in spite of systematic adverse tariffs in the German, French and American markets the British textile manufacturers have not degenerated in resourcefulness, and the number of operatives has not decreased from lack of employment.

Numerous water-falls on the continent of Europe, chiefly in Scandinavia, Switzerland, and Italy and in America are now harnessed for the service of man. Of these the water-power factory at Nottodden in Norway, the power stations at the Niagara Falls on both sides of the United States of America and Canada, the Kinlochleven artificially impounded water-power of Scotland and the water-power station at Foyers in the Highlands of Scotland have all been using the gigantic power derived from the water-falls. Some idea of the immense volume of water may be gained by a mental picture that eighteen million cubic feet of water is passing suddenly over a precipice of one hundred and sixty feet every minute forming the great Niagara Falls, and representing a power of nine million horse-power, of which about five-and-a-half million horse-power is available for the use of man. Only three-fourth million horse-power is being utilized up to now by the huge power stations of the Niagara Falls on both sides of the United States and Canada. The industrial revolutions of the present century will therefore largely depend on the greater *utilization of Nature's Waste Energy* for the service of mankind. Since the introduction of electric furnace and the cheap water-power for the production of aluminium in 1885, the prices of aluminium have dropped down from 20*s.* to 7*d.* to a shilling per pound to-day. Another interesting achievement of scientific manu-

facture is thorium nitrate largely used in the Welshbach Incandescent mantle—the saviour of the gas industry—the price of which has decreased from 55*s*. per oz. in 1894 to 1*s*. per oz. in 1895.

The waste-abhorring science to-day controls the efficiency or economy of all the four factors of industry—its brain, capital, labour, machineries and raw materials. But time and again as was in the past so in the present, the vulpinist in man, human greed, pretence, selfishness, ancient prejudice, the desire to enjoy immediately and without labour, the desire to rob others by plunder and oppression or cheating and other worst cravings and abuses of the body politic, are ever trying to maintain artificial prices by huge combinations or business intrigues, and to secure efficiency of exclusive control or monopoly of business by so-called protection or preference, tariff or fiscal reform, which merely raises the price of the protected commodity of the home market by paying dearly in gold or silver or by the produce of the land, owing to sticking to "duties" instead of efficiency in manufacture, by huge and lying advertisement and by gross adulteration.

The much-vaunted protection, like the man in the moon, is powerless against the inexorable laws of political economy, which controls the secret springs of human activities and the capitals of the world. The industrial world is big enough for all the races of mankind needing the co-operation of each and all "to make enough music in it."

Although the coal tar industry was first founded by Perkin in 1885 in England, yet thanks to the indefatigable labours of Dr. Von Baeyer for thirty-five years that his first triumph of the synthesis of indigo

in Germany—after an expenditure of nearly one-and-a-half crores, of rupees by the "Badische,"—surprised the world in 1897. Thus the Indian Indigo-Planter's occupation to-day is gone. The extensive dye-works of Germany at the present time annually export to other countries artificial dyes to the value of twelve crores including more than two crores of rupees of artificial indigo.

The Free-trade policy under which Britain has prospered all along, is being vigorously assailed in England to-day on political grounds, as other nations had not followed the British example, and the swan-song of the doctrine of retaliation by means of so-called discriminative tariffs or measures of present ease and popularity against foreign protection, finds many supporters in the "British Parliament to the great detriment of that land of common sense." The curse of Babel shall fall on the people when the fleeting rainbow of protection dissolves on the horizon of practical economy. Assuming that Free-trade or Adult-Trade is an aggressive or unjust competition, the protectionists in their zeal scorn the very idea that self-help can be right or useful: thus they put too much faith in so-called systems and look too little to men. The British Free-trade policy, as is often mentioned, did not drive out of existence the Indian indigenous trades, for is not Great Britain herself dependent upon Germany, America, India and other countries for much of her raw materials? The history of the sugar industry of India shows clearly that measures of protection cannot avail us, for the improved methods of cultivation and manufacture have enabled Java and Austria to overcome the obstacles of countervailing duties. In spite of old pre-

judices, the Indian market is big enough for Japan and Germany or England and America.. Owing to interdependence of the capitals of the world and the prosperities of the nations, the Great Powers of Europe, in spite of their colossal armies and costly navies and the alarming preachings and prophesies of their political pundits and prophets of evil, could not confiscate the trade of the smaller states like those of Switzerland, Holland, Belgium, Denmark, Sweden and Norway. In commerce the gain of one nation is not the loss of the other, for commerce enables both the nations to save labour and expense in the production of commodities.

In India labour, capital and brain are not so much wanting for the industrial advancement, as are the moral and social qualities, enterprising spirit, trade honesty and co-operation (Vis inertiæ and conservatism).

## The Industrial Progress of India as the Result of British Rule.

When England learnt the art of weaving from the Flemish weavers, purple cloth from India was the commodity brought by sea to London, as is mentioned by Fitz-Stephen—a monk of Canterbury of the time of King Henry II. All through the middle ages to the modern time before the advent of the power-looms, India used to make cotton-goods for Great Britain, and her export attained its zenith during the palmy days of the East India Company. With the advent of steam, the opening of the Suez Canal and the establishment of the Indian Railway System, the Indian hand-weavers could not compete with the cot-

ton mills of Lancashire and Bombay. The spinning of yarn by hand is a dead industry, and very little room is left for the hand-weaver's industry. India lost her monopoly, it is transplanted to Lancashire, and now Great Britain makes them for India. Indeed the bug-bear of competition was such that even in England the woollen, linen and silk manufacturers with strange short-sightedness, opposed the introduction of the cheaper cotton manufacture by the Huguenots. Thus in 1712 an excise duty of 3*d.* per yard was imposed on all calicoes made in England, and it was raised to 6*d.* per yard in 1714, and the manufacture of cotton fabrics was finally forbidden in England in 1721 by heavy fines imposed on both the sellers and buyers of calicoes. Notwithstanding, cotton manufacture could not be strangled in this way by Parliamentary enactments and the vehement opposition of vested interests. Up to 1736 cotton manufacture was an illegal industry in England, and it was not until 1774, that the manufacture of entire cotton goods was allowed. Thus it was the steam engine that precipitated the revolution in the labour system of the whole world. In 1785 Watt s steam engine was applied to cotton factory, and the whole aspect of the world's textile manufacture was changed Within 1788 there were one hundred and forty-three cotton mills in Great Britain, transforming Lancashire into a vast hive of cotton industry. When machine after machine was introduced in the textile industry, the operative classes being seized by panic, thought their means of livelihood were taken from them by reducing their labour and wages. John Kay, the inventor of the fly-shuttle, was attacked by the weavers, who threatened his life, and he escaped to France and died

a pauper. Hargreaves—the inventor of the spinning jenny—was attacked by his neighbours and his jenny destroyed, which was followed by serious spinning jenny riots at Blackburn. Falling prices, bad harvests, low wages, war with the United States and the Napoleonic Wars with France, all brought on a general commercial distress in 1811, which culminated in the stocking-frames and looms-breaking riots at Nottingham known as the *Luddite Riots*. In 1813 fifteen persons had been publicly executed for the offence of Luddism before the activities of Luddites were put down. The great enemy of man is man ready to do evil not only to others but to himself. Thus it is that ignorance and superstition of the common people, like a moral distemper, cause greater calamity than plague, famine or fire. England became burdened with a debt of nearly £1,000,000,000 sterling at the end of the Napoleonic Wars in 1815, and British commerce was entirely deranged. But her power of recuperation was quick and great, and this depression was soon made up by extended trade and the work of invention. Navigation by steam-boat was adopted in England in 1815. By 1840 ocean steamship travel became a success. Thanks to the inventive genius of George Stephenson, the Liverpool and Manchester Railway was inaugurated in 1830. With the inauguration of the *railway era*, high prices, starvation, riots, strikes and fierce agitation became less and less. By 1850 the British vessels had increased to 27,745. The interdependence of trade relations between two countries is best understood by the effect of the outbreak of *the Civil War* in the United States in 1861. In England everywhere the cotton mills of Lancashire were stopped owing to the

stoppage of cotton supply from the United States of America, reducing a working population of one lac and fifty thousand wholly dependent upon charity for four long years. To-day the cotton mills of Lancashire represent a capital of £100,000,000. They produce £90,000,000 worth of goods every year, and export £70,000,000 while thirty lacs of persons are engaged in the trade. More than 900,000 British looms and one million textile operatives are engaged in the entire Textile Industry using cotton, wool and worsted, silk, flax and jute fabrics. As regards raw material, Lancashire is still at the mercy of the United States, for more than eighty per cent. of the whole world's long staple cotton crop is supplied by the United States. Moreover, cotton goods are being manufactured in the United States from 1800, where 661,451 wage-earners are to-day employed in the textile industries. Large quantities of cotton are also exported from India and Egypt to England. It has been estimated that the number of spindles in the world has grown to one hundred and twenty-nine millions in 1908. In the United Kingdom the number of spindles is fifty-seven millions, and that of looms is 739,400 in 1909.

Thus the doom of the *Indian Textile Industry* resting entirely on the handicraft basis, was a foregone conclusion, and the proscription of the Indian cotton goods in England under the erroneous idea of securing the complete monopoly of the home market to the home manufacturers by exclusion of foreign competition during the early parts of the nineteenth century, was an insignificant factor, and not the real cause of the ruin of the Textile Industry of India, as is so often mentioned.

Little reliance can be had on *bounties* and *protection*

before the radical inventions of Kay, Wyatt, Hargreaves, Arkwright, Crompton, Cartwright and Watt. The exports and imports of a country are, like the arterial and venous channels of its economic body, and bounties and premiums on exportation, countervailing duties and other artificial restrictions on importation, like thombosis or embolism interfering with the life and liberty of trade, will ultimately either cause dropsy or gangrene of its body politic, or make room for the establishment of a natural "collateral circulation" in the limb of trade. Thus despite obstructions and impediments, nature will find its own way. Protection like cunning is no wisdom. Commodity, like science, knows no country or people. Commerce means exchange of commodities by exports and imports on the principle of give and take. Protection without commercial honesty destroys the development of the latent power of industrialisation in a nation, as it has a great debilitating effect on its industrial character. Moreover, preference or retaliation, like the principle of Mahomet and the mountain, will not only make an increase in the price of the protected commodity but a vast deterioration in its qualities; and the natural equilibrium being thus barred, the burden on the consumer becoming more and more intolerable, will inevitably cause a rupture in the highly tense tariff membrane. The prophylaxis of protection frustrates its own end, for, instead of retarding the growth of foreign manufacture, it encourages indirectly its growth. *Boycott* and *protection* of manufactures by means of tariff barrier will also beget retaliative counter movement. In 1608 King James by a sudden stroke of commercial policy prohibited the sending of

woollen cloths to be dyed in Holland by granting to Alderman Cockayne, the sole right of dyeing all woollen cloths. The result was Holland and Germany combined to close their ports to English cloths, and the woollen manufacture in England immediately felt the pinch, and the prohibitions had to be withdrawn in 1615. It is clear, therefore, that it would be futile to stem the tide of trade between nations like Canute's attempt to stop the tide of the ocean. If export is checked or arrested, there may be a simultaneous arrest of the import as well. The *international trade relations* of two countries are not like maternal and fœtal relations, that you can nourish the embryo or nascent trade of one country by so-called *temporary* bounty and protection or artificial sustenance before the infant trade is matured into manhood, or that you can kill a struggling trade by cutting off the blood supply of its mother by means of the suicidal *policy of the boycott.* Self-sacrifice or mere sentiment has no place in business relations. Over-protection, like drunkenness (for there can be no moderation in tariff), will ultimately bring on national decay. Artificially nourished industries shall have to be kept going by continuously increasing doses of artificial means till the burden on the consumer becomes intolerable, and he rebels. Mere *Protection* or help from without, cannot make the idle industrious. Effort from within is more necessary than effort from without for the industrial independence of a race. Without the gift of industry and perseverance, and the endowment of heart and brain, no legislative enactments can make a people industrious by supplying the profitable energy which it sadly wants. As well one might take a horse to

water, but one cannot always make him drink. If he is thirsty, your so-called "facility" is little needed. The *doctrine of protection*, like the doctrine of chance or good luck, is a refuge of weak and unstable minds, for the serum of protection will make the people immune from self-exertion ever afterward. Precocious or inefficient industry reared by selfish protection sacrificing efficiency to policy, like a hand-fed child, is an unjust and degenerate kind of commerce, and will sooner or later meet an untimely death or disappointment. Whether the Government of a country abandons Free-Trade Policy and relapses into its old fallacies or not, it is easy to foresee that protection can no more create a ready-made and easy-going industry for the people than the dreams of an Alnaskar and a pre-Columbian visionary can create a fortune and the discovery of America, or a "happy hit" of so-called accidental discovery can create inventors or discoverers in the field of science. The universal spirit of commerce or self-interest of mankind is inconsistent with the selfish and shallow policy of *unjust monopoly* produced by restrictive regulations or by the depression of the trade of a neighbouring country, caused by the envy and dread of others in wealth and civilization—for the laws of political economy which control the protection and distribution of wealth or the abundance of various necessaries, conveniences and enjoyments of human life, are the same in every country and in every stage of society.

*Indian Industries*, conducted in a small way, and by the hand without looking to the quality or quantity, and the efficiency or cheapness in manufacture by improvement in details and by labour-saving contrivances,

will inevitably succumb in the long run to competition with the factory labour. Ill-considered projects of well-meaning enthusiasts, depending upon so-called abundance and cheapness of unskilled Indian labour, will bring certain ruin for their weakness and sentimentality. Blind patriotism and conservatism cannot foresee *the survival of the fittest* in commerce, or the projectile path of its price factor, and no kind of production can continue long to sacrifice the interests of *consumption*, the end of all production.

It is idle to boast that the hand-sewing will compete with the sewing machine, penmanship with the printing press, or the fly-shuttle with the power-loom. No form of weakness and sentimentality or theories should stand in the way of removing the abuses from the body politic, for a bad tool is as much the ruin of a good craftsman as a good tool in bad hands. If moral and physical evils are to be found in labour in mills, they are equally conspicuous in cottage industries; and laziness, intemperance and other moral evils are no less constant among the working classes of India. Any conclusions, therefore, from the course of present events based on what had happened in the past without counting for new men, new methods and new environments, cannot be made by our past standard of antiquated methods. It would require even more than the entire agricultural population of India to spin and weave by hand-labour in order to supply the amount of cotton goods turned out by the aid of machinery, for the existing number of 11,000,000 of weaver caste people of India cannot meet her modern demand. The survival of the fittest, whether in Biology or in Industry, must take cognizance of the change of environment.

The *history of the sugar industry in India* shows clearly that measures of protection and the handicap of freight charges, cannot check the exports of Java, Mauritius and Austria with their improved methods of cultivation and manufacture, which vastly multiply the natural resources and the economical efficiency of the time and place values of their commodities. At the Industrial Conference at Benares, the Gaekwar of Baroda pointed out that high "import duties were powerless to effect any permanent improvement" and to protect a hopelessly inefficient Indian industry such as sugar from fair competition. The world's production of sugar, excluding India and China, is nearly one crore tons. India herself is the largest producer of sugar in the world, and her crop of cane sugar yields about 5,000,000 tons of sugar; still India imports at the rate of 500,000 tons yearly, giving four lbs. per head of the population. The value of the import of sugar in 1909 was over ten crores of rupees. The *beet sugar* industry as a rival of cane sugar industry, began in France, and spread to Germany, Austria, Hungary, Holland, Belgium and Russia. The continent of Europe grows fifty-million tons of beet sugar. More than half the world's production of sugar is derived from the beet. Scientific cultivation and extraction of sugar from the beet root shows that whereas in 1836 a ton of beet root yielded one hundred twenty-four lbs. of sugar, in 1871 the same yielded two hundred and four lbs., and in 1900 yielded three hundred lbs. of sugar. Sugar is not grown and manufactured in Great Britain. England imports appalling quantities of sugar worth more than thirty crores of rupees annually. The annual consumption per head of the population, is about eighty

lbs. The consumption of sugar in the United States is about sixty-eight lbs. per head. The Louisiana and Cuba cane sugar industries have been killed by civil wars. The United States of America now manufacture about one-tenth of the sugar consumed by them, and refine vast quantities of raw unrefined brown sugar which they import. The number of beet sugar factories was fifty-six in 1903. The sugar refining industries of the United States have now been controlled by the Sugar Trust since 1892. The "bagasse" or waste by-products of sugar manufacture is thrown away or used as fuel in India. It might be more profitably utilized as wood-pulp when mixed with banana, bamboo, grasses and other fibrous materials. One ton of sugar will give one ton "bagasse" of which about two million tons valued at 15 crores of Rupees are allowed to go waste in India.

Thus the foundation of all industrial advances is laid by the *workers in pure science*, and no better example can be cited to-day than that of the synthesis of indigo in the laboratory by Von Baeyer in Germany which has successfully wrought the ruin of the Indian indigo planter, and thus dislocated a Great British Industry of India. Of course in certain classes of work artificial indigo cannot compete. The natural indigo is extensively used in making the khaki of army clothing. To-day the German system of *Technical Education* is the admiration of the world. But Great Britain is not less awakened up to the fact of technical education, and the question is not of recent date as it is also mentioned in the "Mathematical Magic" written about 260 years ago. Excellent technical schools and colleges have largely been established in England, France and America.

In spite of the doubts and fears of alarmist politicians, Great Britain has not "slowed down" in her industrial effort. If Germany has excelled Great Britain in certain industries by virtue of her technical education, co-ordination and co-operation and state subventions in industrial enterprise, it is because there is to-day not only a survival of the fittest, but of the weakest in great number and in comfort too, thanks to the labour-saving machinery and science.

The extreme love of leisure, the fewer material desires and wants, the disposition to lean on others and to hang together in joint families, to live in idle dependence, the enormous economic waste of money in ceremonies and jewellery, the neglect of regulated charity by maintaining about 50 millions of able-bodied beggars by indiscriminate alms-giving, and the consequent policy of living up to the limit of income, the iniquitous early marriage which gives us hostages to fortune and enterprise, the backwardness of female education, the passion for extravagant expense even by borrowing predominating over the passion for accumulation, the passion for the ruinous luxury of litigation, the absence of the spirit of emigration and the interdiction of the sea-voyage are the main causes that stand in the way of *Indian Economic Progress.* The income-tax statistics shows clearly the ease-loving nature of the educated section of the people. For next to Government service the educated Indians have a great preference for the parasitical professions of barristers and legal practitioners, and the Indian capitalists have a preference for usury and real property.

The *two great factors* that act on the economic progress of India are the Government and the British

capital. The Government of India disseminates agricultural and commercial knowledge, experiments with new industries, and provides railways and irrigations to insure against the failure of the monsoon. The enormous jute, coal, tea and cotton industries of modern India are entirely due to British capital and energy, and the *result of British rule.* If the monopoly of the older cotton industry dwindled into insignificance, the giant of *jute production* and its manufacture has reared its head in its place, and India to-day virtually retains a monopoly of the same. The export of jute from India is valued at £24,000,000 a year (Rs. 36,00,00,000). There is a romantic *history of the origin of the tea industry in Assam* by the prophecy of pure science. A sample collection of butterflies was sent from Assam to England, and it was predicted by a professor of Entomology that, as butterflies feed on the tea-plant, there must be tea in Assam, and the result was the discovery of wild tea forests in Assam, which has resulted in the grand Indian tea industry of to-day, in which £20,000,000 of English capital has been invested, yielding an export value of £6,000,000 yearly. Tea companies are now composed of educated Indians. Indigo is also in the hands of the Indian capitalists, specially in Madras.

Manufacturing industry is rapidly increasing *amongst the Indians.* Mining enterprise is also in the hands of the Indians. Many coal mines are possessed by Indian owners. Mills and factories are being established with purely Indian capital. Bombay showed the way by starting spinning and cotton mills by steam-power, and still holds the first rank in constructive enterprise. Bengal now possesses five cotton mills—namely—(1) The Bengal Luxmy Cotton Mills

Limited; (2) The Mohini Mills Limited (Kushtea); (3) The Ganesh Cloth Mills; (4) Bharat Abhyudaya Cotton Mills at Ghoosoorie and (5) the Oriental Jute and Cotton Mills Limited. There are five soap factories in Bengal, three match factories, three tobacco factories, one glass factory, two hosieries as also shoe-making, cigarette-making and button factories in a small way. Pens and pen-holders, pencils and knives and other articles of daily use are now prepared in the country. There are native cutlery manufactures at Kanchanpur, Shaspur, Wazirabad; and one in Calcutta belonging to Messrs. Khan & Co. The North-West Soap Co. at Meerut and Calcutta was started in 1879 with a capital of over nine lacs of rupees and employing over 500 hands daily. There is the Kaiser Soap Co., at Cawnpore. The Bengal, Oriental, National and a few other small soap factories in Bengal are also owned by Indians. There is the "Monoroma Candle Factory" at Dinajpur.

The Gujrat Islam Match Factory has been started at Ahmedabad as the result of Mahomedan enterprise with a capital of one lac of rupees. There is another match factory at Kotah in Bilaspur. The Berar Match Manufacturing Company of Ellich, Ellichpur, is a joint stock company with a capital of one-and-a-half lac of rupees. In Bengal, the Bandemataram Match Factory in Calcutta was started by Dr. Rash Behary Ghosh with a very small capital of Rs. 10,000, and the Oriental Match Factory has been established at Konnagar. The Deccan Match Manufacturing Company at Satara, the Karnatik Match Factory of Dharwar and the Western India Match Works are the three recently started match factories of Bombay.

In these days of synthetic chemistry, the match making industry would be revolutionized, if some Indian brain successfully utilized the current coin of knowledge to make the discovery of the *Paper match* direct from the wood pulp.

In *Insurance* and *Banking* the Indians are already making some progress. The Co-operative Hindusthan Bank Limited and the Bengal National Bank Limited are the two Insurance and Banking enterprises managed by the people of Bengal.

The East Bengal River Steam Service Limited, and the East Bengal Mahajan Flotilla Company are two *Bengal Steam-ship Compan es* managed by the Bengalees.

The *number of mines* in 1906 was about seven hundred and fifty including the three hundred coal mines of Bengal (out of a total of *four hundred coal mines in India*) which employ about one lac of labourers. Sixteen kinds of minerals are worked out in India. In the case of coal there has been a continuous increase in the Indian output from four million tons in 1897 to twelve-and-a-half million tons in 1908.

Next to coal, manganese now stands third amongst the minerals produced in India, and to-day it takes the first place among the world's producers of manganese ores in spite of the formidable competition of Russia.

Mills have been established at Bombay, Delhi, Cawnpore and Calcutta. The total number of mills in 1907 was 1718. Over five lacs of poor persons are employed permanently in the mill industry. There are fifty different kinds of mills in India, namely:—fifty-six oil mills, ninety-two rice-mills, fifty-four flour mills, four silk mills, sixty-eight saw-mills, rope works, forty-four jute mills employing over a

ac-and-a-half men and producing goods worth £11,000,000 a year, six woollen mills, ice and ærated water factories, sugar factories, kerosine tin works, lac factories, eight paper mills employing over four thousand persons, pottery works, soap factories, printing presses, fifty-one iron founderies, forty tobacco factories, twenty-six breweries, bone-mills, tanneries, chemical works, dairy farms, dockyards, railway workshops. "Steel-works are now being put up with native capital to manufacture with native iron and native ore." The pig-iron and steel manufacture by the Tata Iron and Steel Co. has been established in the Singhbhum district. The *Barakar Iron Works* is the only successful attempt to manufacture iron along European lines in India.

The Bengal Silk-mill Company is the result of Mahomedan energy and capital, and was started about 1882 in Calcutta. Five big Bombay Cotton mills are managed by Mahomedans. Of the thirty sugar factories working in 1910 nine exclusively belong to the Mahomedans. The Bengal Steam Navigation Co. is a Mahomedan enterprise. The Bengal Chemical and Pharmaceutical Works Co., Ld., was established in 1892 with a capital of Rs. 25,000 through the efforts of Dr. P. C. Roy with the co-operation of his friends. It was turned into a Limited Liability Company with a capital of three lacs of rupees of which Rs. 1,20,000 is represented in building and Rs. 60,000 in machinery; it is now giving a dividend of six-and-a-half per cent. per annum. Recently an Indian Pencil Factory has been started at Anakapalle and another in Calcutta. The Calcutta Pottery Works, the Bengal Pottery Works, and the Eureka Porcelain Works are managed entirely by Indian capital and labour. Babu

Akshoy Kumar Saha, the chromo-litho artist, who may be regarded as the Ravi Varma of Bengal, has founded from a very small beginning the now famous "Chorebagan Chromo Art Studio," Calcutta, worked by electric power. Of the few nib factories recently started in India, the Gwalior State Nib Factory, the nib factory of Tambat Brothers, Bombay, and the Gujrat Nib Factory, Punjab, deserve mention.

The first cotton mill in India known as the Fort Gloucester Cotton Mill was started in Calcutta in 1829, but it was not a success. The number of cotton mills in 1908 came up to two hundred and twenty-seven employing about two lacs and twenty-five thousand hands with a joint stock capital of Rs. 14·93 crores engaged in the industry. The number of spindles in India is about 5,875,798 and the number of looms about 72,931. The cotton spinning and weaving by power had its inception in Bombay. The first cotton mill was started in 1854 in Bombay. It is still essentially a Western India Industry. The cotton industry of Bengal finds it hard to compete with the natural cotton centres of Bombay that possess a larger choice of staples and the advantages of skilled labour. With the introduction of the steam spinning and weaving into India by the enterprising Parsis of Bombay—the Manchester of India—the Sassoons, Jeejeebhoys and Petits, are known all over the world The mill-made cotton yarn and piece-goods of Bombay are mostly exported to China and Japan. If the manufacturing population of Bombay were to rely chiefly for their maintenance on the demand for their productions at home then they would starve during an inauspicious year when all marriages with their gifts of cloth are postponed in India. The two

hundred cotton mills of the self-trained and self-reliant Parsis of Bombay show clearly that in spite of plague, famine, over-production, shortage of cotton crops, fluctuation in price due to inauspicious years at the home market and the handicap of three-and-a-half per cent. countervailing excise duty and other ups and downs in trade, they are ably maintaining themselves. We should, therefore, shout a little more on the needs of individual enterprise and self-help than to cry hoarse for a mechanical state support to act the part of a foster parent to hatch the golden eggs of our industry by a huge state incubator. What a mighty opportunity of *industrial self-government* is lost here?

The main *industrial problem for India*, as Professor Lees Smith, M.P., author of "Studies in Indian Economics" and "India and the Tariff Problem" observes, is not the industrial serfdom and the economic subjugation of the Indian artisan by means of high tariff wall but by the bracing effects of competition.

## The Prosperity Problem of India and the so-called Economic Drain Theory.

Some very wrong notions exist that India is drained of her wealth under British rule. The benefits derived by the enormous development of India's resources and the employment of her labour in *tea growing, coal mining*, the *jute industry* and other enterprises are regarded as the merciless exploitation of India's resources by British capitalists, for it is said that the earnings produced by these industries do not remain in India and hence contribute to its impover-

ishment. The frequent outbreaks of famine in India are due to failure of the monsoon and not to a scarcity of money The Government of India preserves the lives of its subjects during actual outbreak, by "relief" works. Railways, irrigation and co-operative credit banks have been introduced to fight out famines. Famine does not prove that India is being depleted by the Government.

Great Britain has not, indeed, impoverished India, on the contrary her *volume of trade* has increased immensely. The total value of *sea-borne trade* in 1906-1907 was twenty-three crores of pounds sterling as against two crores of pounds in 1840. The imports into India during 1909 were £80,561,000 and the exports from India during the same year £112,431,000. If *hoarded wealth* is a sign of a country's prosperity then the immense amount of hoarded wealth in India is not less than eight hundred crores of rupees, and moreover a country cannot grow poorer with an ever-increasing volume of trade The commercial classes have prospered greatly and millionaires are not unknown now. The legal profession has flourished enormously. Even servant's wages and coolie's wages have greatly increased. Their clothing has improved immensely. The *condition of the Indian labourer* and the ryot is growing better in spite of the statistical absurdities of the so-called "Drain Theory." The *Public Debt of India* is mostly due to railways and irrigation works. In 1857 the Public Debt of India was about £51,000,000 which was further increased by £52,000,000 on account of the cost of suppressing the Indian Mutiny. From 1857 to 1900 the Permanent Public Debt of India has increased to £205,300,000 of which ordinary debt was £69,996,000 and the Pub-

lic Works Debt £135,327,000. The Public Works Debt is, however, becoming a profitable source of revenue to the Government and is really not a "drain" to the country. The ordinary debt of India is considerably less than the revenue of a single year. The Indian Government is economical in its aims and its efficiency. "The growing trade, expanding revenue without increased taxation and improving land values" tend to prove that India is not growing poorer under British rule. The relatively greater poverty in India than fifty years ago is largely due to the high cost of living and better ideas of comfort brought by an improved and costlier standard of living owing to the *influence of Western Civilization.*

## The Revenue and Taxation and Government State Expenditure.

India pays no tribute to England. The so-called tribute or home charges are due to (1) *Public Works Debt* for the railways and irrigation works; (2) *Military Debt*; (3) *Pensions*; (4) *Maintenance of the India Office, British troops and purchase of stores*, etc., and (5) *Private remittances.* In all these India has had to pay for value of the services received, a sum amounting to £20,000,000 sterling per annum. The cost of internal administration of India, the cost of the British Army and Navy for the efficient administration and the security from outward attack and inward disorder, and the charges for the India Office are all borne by the Indian revenue.

The *chief source of Government revenue* is not taxation but *land revenue* amounting to about thirty crores of rupees per annum The revenue of Akbar

was about sixty crores of rupees, being twice as much as the British obtains now. Under the ægis of the most enlightened Hindu and Mahomedan rulers of India in the past, the system of land revenue was higher than that of the present British system. Under Emperor Akbar it was thirty-three per cent. The Mahrattas levied fifty per cent. The old native rulers of Bengal took fifty-four per cent. The Sikh Government in the Punjab claimed from forty to fifty per cent. The British Government now levies from three to eight per cent. on the average. The other sources of revenue are forests, commercial services, and income from the post offices, the telegraphs, the railways and irrigation works. Revenue from taxation is derived chiefly from *salt*, *excise*, *customs*, *stamp duties* and the *income-tax*. The *State Expenditure* falls under twelve departments, *viz.*—(1) Judicial and Executive; (2) Police; (3) Education; (4) Medical; (5) Military; (6) Postal; (7) Telegraph; (8) Public Works Department including Irrigation and Railways; (9) Marine; (10) Survey of India; (11) Political; and (12) Ecclesiastical. The total average income from all sources of revenue amounts to about one hundred and thirty crores of rupees per annum, leaving an annual surplus of nearly four crores, after meeting the entire State Expenditure.

## The Industrial Exhibitions and their Utility.

The importance of industrial and agricultural exhibitions cannot be denied as having an educational value, for they tend to spread a knowledge of industry and agriculture, encourage arts, industries and trade and suggest new ideas to observers for the establish-

ment of new industries and the improvement of old ones.

Various *religious fairs or melas* were the forerunners of the modern Indian exhibitions. Numerous bathing fairs are annually held by the Sannyasis or monks of India at places on the great rivers, *viz.*—the *Kumbha Mela* at Hardwar, Allahabad, Ujjayini and Gautami at Godavery.

Various *industrial melas* are also held annually on some public occasions. The famous mela of *Harihar Chhatra* is held annually at Sonepur. The Pushkar horse and cattle fair is held annually at Ajmere.

The *first exhibition in Europe* was held at Paris in 1800. The Great Exhibition of London in 1852 was the first exhibition of Great Britain followed by the Philadelphia Exhibition of the United States of America in 1876 and the Chicago Exhibition of 1893. The Great Paris Exhibition was held in 1900.

*Indian Exhibitions of modern time*:—

1. The Bombay Exhibition during the administration of Lord Dalhousie was the first Indian Exhibition of the modern time.

2. In Bengal the Alipur Agricultural Exhibition was held during the Lieutenant-Governorship of Sir Cecil Beadon.

3. The Indian Museum Exhibition was held during the Lieutenant-Governorship of Sir Ashley Eden.

4. The first Provincial Exhibition at Allahabad took place in 1864.

5. The Great International Exhibition of 1884 was organised by Dr. Joubert and held at the Calcutta Maidan.

6. The Indian National Congress Exhibitions were

held in Calcutta in 1901, at Guzerat in 1902, in Bombay in 1904, at Benares in 1905, again in Calcutta in 1906, at Surat in 1907, at Nagpur in 1908, and at Lahore in 1909.

7. The Great United Provinces Exhibition at Allahabad held on the 1st of December, 1910, has been organised by His Honour the Lieutenant-Governor Sir John Hewett, K.C.S.I., C.I.E., for promoting the advance of Indian Industries and Agriculture and providing object lessons and inspirations for all classes of the Indian community.

The Government of India have advanced five lacs of rupees towards its cost and 3¾ lacs have been subscribed by the people of the United Provinces.

The Exhibition is best described in the words of Mr. Justice Richards, the Chairman of the Exhibition Committee:—"Encouraged to meet in a spirit of generous emulation, East and West now display before agriculturist and manufacturer, before producer and consumer, before all classes in one small 'cosmos,' what Eastern experience hoary with the wisdom of centuries can suggest, what Western science rejoicing in the energy of highly trained brains can evolve, and the golden heights to which the combination of these two forces can elevate mankind."

Exhibitions are now also held annually throughout India at every zilla of the East and the West Bengal as also in the other provinces of India.

## Sea-voyage and Maritime Commerce of Ancient India.

Long before the Phœnicians became the first sailors of the Mediterranean Sea, maritime trade had

existed in India and China. It is a matter of fact that the Saracens of Egypt and Syria, the Grecians and the Romans had active commercial intercourse with India till sea-voyage was interdicted among the ancient Indo-Aryans. It should also be borne in mind that the people of India, whether by blood or by faith, was never then or is now one people from a primitive stock but was more or less an intermixture of all the world's then existing races and creeds, and that the origin of the so-called caste-divisions could not, therefore, have any significance as a creed or a race unification during the Vedic Ages, but it was then merely a class division based on industry and division of labour and brought together under one commercial unity during the zenith of the prosperity of ancient India. Once the spirit of Hindu enterprise and colonization penetrated in Siam and even in the islands of Java and Bali, the temple architectures of which places testify to-day the Hindu influences they had in ancient time.

In ancient time the products and manufactures of India were highly valued in Europe, and in the middle ages the Arabian traders carried Indian commodities to Constantinople and thence they found their way into Italy. From time immemorial the celebrated Dacca muslins of India known as the "webs of woven wind" and fabrics of silk, ivory carving, goldsmith's work and jewellery, gems, diamonds and pearls of India, were proverbially famous in the market of Europe. Commerce with the East made Venice and Genoa in the middle ages, what Tyre and Carthage were before the Christian era. For about a thousand years the demand throughout Europe for *silk* was supplied from India

and China. About the middle of the sixth century A.D. the silk industry spread into the Italian Peninsula, and for several centuries the manufacture of silk in Europe was confined to Italy. *John Lombe* successfully wrested from the Ital ans at the risk of his life, the mystery of the thrown-silk industry and introduced it into England about 1718. Italy long maintained her monopoly of the trade of the Mediterranean Sea. The sea-route to India was discovered by Vasco-da-Gama, the Portuguese navigator in 1497. "For a century till 1600 A.D. the Portuguese monopolized the Indian Trade." The Dutch, the Danes, the Germans and the French then successfully had the mastery of the sea till the advent of the English in the Indian soil in 1600 A.D.

It will thus be seen that the Indian maritime commerce was as old as that of China and even older than the Mediterranean commerce of the Phœnicians. Before the interdiction of the sea-voyage by Manu, the ancient Indians were quite familiar with ships adapted for sea-voyages Allusions to ships are numerous even in the Rig Veda. The Code of Manu laid down rules for the guidance of maritime commerce. The Vaisyas or Baniks were the commercial class of the Aryan Common-wealth as early as the days of Valmiki. The Ramayana alludes to merchants who trafficked beyond the sea, and mentions that the Banik succeeded in his commerce in consequence of the great benefits obtained by studying the Ramayana. In the Mahabharata mention is made of ships provided with machinery. Mention is also made of the Baniks in the "Bhattikavya." The poet Kalidas gives the story of the merchant "Dhanabriddhi" in his Sakuntala. In the Hito-

padesha—a Sanskrit compilation of fables and morals by Vishnusarma—the merchant Kandarpa-ketu and his ship are described. The details of the piratical expedition of the Bengali Prince Bijaya Sinha to Ceylon with seven hundred men about 543 B.C. are familiar to the readers of the history of Ceylon. The Baniks of our day represent the Vaisyas of old. The Bengali Vaisyas or Baniks traded the sea-coasts in small boats. The illustrious merchants Dhanapati, Srimanta and Chand, who sailed to Ceylon in the fifteenth century, carried on a sea-trade with the Indian Archipelago and even as far as Egypt. Sripati, Lakshmapati, Dhanapati, Srimanta and Chand are historical names, and form the heroes of the Bengali works of "Manshar-bhasan," "Mungle-Chandi," "Padma-Purana" and other religious works. The folk-tales of Bengal even abound in stories of the king's son and the merchant's son as friends and equally honoured on the same footing.

To-day the Sikhs freely emigrate to China, the coolie class even will have no scruple to cross the sea for higher wages. Of the coolie class, the *chamars* of North India, the *mahars* of Bombay and the *pariahs* of Madras, forming about ¼ of the Hindu population of India to-day, supply the mill-hands of Bombay and Calcutta, and form emigrants to Natal, Mauritius, West Indies and to Fizi. More than a million of them are engaged in Canal works, in Railways and in Tea-gardens of Assam and Ceylon. Even the Rajput Banyas or trading caste have their shops throughout the Northern India extending as far as on the extreme frontier of Assam. They have also pervaded throughout the length of Egypt and in South Africa.

It is idle, however, to boast of the timid coasting

trade of India by sailing ships (galleys) in the pre-British days as comparable with that of the modern commerce, since the introduction of the iron-clad ships in 1873 on the advent of the steam navigation in the nineteenth century. Indiscriminate admiration of the past is a palsy of many Indian minds, making Indians dreamers in the industrial world.

There was no international exchange of surplus commodities in ancient time. With the interdiction of the sea-voyage by Manu, and the greater divisions and sub-divisions of the four primary castes or class divisions into thirty-six mixed castes (giving rise ultimately to over two thousand species of mankind) formed on a more rigid basis after the downfall of Buddhism in India in the fourth century A.D., India chose to live a life of selfish independence or isolation which patent cause ultimately ruined her active maritime trade. She became thenceforth more and more passively commercial and ever waited patiently for the actively commercial nations to come and get her precious stones, pearls, silks, linens and Dacca muslins. What little trade was left was done by the adventurous Vaisya Baniks or merchants of Bengal. The Baniks of Gour, Murshidabad, Birbhum, Burdwan and Saptagram carried on their trade with the Portuguese merchants of Hugli and Bandel 1527—1640, with the Dutch of Chinsurah 1656—1824, with the French of Chandernagore 1673—1816, with the Danes at Serampore (1616), and with the English of Hugli (1640) and Calcutta in the seventeenth and eighteenth centuries when sea-going ships were able to come right up to the ports of Chinsurah and Hugli. The Subarna Baniks were at one time the millionaire "Mutshuddis" or Banyans of the big European merchant "houses" of

Calcutta. The name of Madhub Chandra Dutt of Chinsurah occurs as the first famous broker of English merchants, who amassed a great fortune and formed the hero in Kerr's "History of a Bengal family." Among the Subarna Baniks the late Maharajah Durga Charan Law was the prince of merchants in Bengal. Among the Gandha Baniks Butto Kristo Paul, the famous Chemist and Druggist, is a household name in every village of Bengal. Like the Pencil manufacture that has continued for generations in the famous Faber family of Germany, the manufacture of wax candles in Bengal by the French process introduced amongst the Gandha Banik Traders of Chinsurah—the land of the Baniks—about 1757 (then in a most flourishing condition) has continued on the same scroll of fame in the single Wax Chandler family of author's uncle Babu Krishan Chandra Sadhu, zamindar and the distinguished and only candle merchant of Chinsurah, whose pious grandfather Babu Banshidhar Sadhu remembered to have seen the business existing for three previous generations in the same family. At the present time the Gandha Baniks and the Subarna Baniks of Bengal number about ten lacs, the former numbering about two lacs.

In Bengal the Marwaris of Rajputana now occupy the promiscuous place in general trade.

The trading class of the United Provinces is known by the name of "Banyas." In the Bombay Presidency the Parsis, the Banyas of Guzerat and the Marwaris of Rajputana are the most prosperous traders.

The most enterprising Mahomedans of Bombay, Chittagong and Calcutta are keen and adventurous traders. The Mahomedans of Bombay trade with East Africa, and those of Chittagong have developed

the commerce of Rangoon. The Parsis as brokers, merchants, contractors, ship-builders, mill-owners have contributed largely to the prosperity of Bombay.

## The Indian Political Economy and its History.

The Hindus invented sixty-four fine arts as mentioned in Brihat Sanhita, Sukra-niti, Parasar Sanhita, Niti-sara of Kamandaka, Chanakya and other Artha-sastras. The most important of the fine arts of ancient India were dancing, singing, tingeing the teeth, dressing the hair, dyeing the feet of a woman as is still done by the barbar women, carpentry, painting, portrait-painting, sculpture, architecture in stone and brick, writing of inscriptions, engraving on gold, silver and stone, masonry, toy-making and perfumery.

Of the *four means* of securing the national wealth commerce holds the highest place and brings in the maximum fortune, half of which agriculture gives and one-fourth of which service under Government, and lastly the least is obtained by beggary; it may be noted, however, that the above order is now reversed and beggary as a profession thrives well in the Indian soil.

Before the days of Adam Smith—the modern father of Political Economy—whose "Wealth of Nations" appeared about 1776, even in Europe commerce was not esteemed and was synonymous with cheating. War was considered as robbery and agriculture as the only honest source of wealth. Agriculture was then solely carried on by the institution of domestic slavery. During the middle ages when individuality

was unknown among nations ruled by the Aristocracy and the clergy, there were only four learned professions,—those of theology, law, medicine and philosophy. So it is not curious to find in India that most of the seven means of acquiring, a *nation's wealth* as mentioned in ancient Hindu Political Economy appear to be not very honourable, *viz.*—(1) the sale of spices; (2) mortgaging on the principle of Shylock; (3) management of Wards' Estates generally with a view to misappropriation; (4) cheating familiar and confiding customers; (5) declaring a false price of purchase; (6) giving less in weight; and (7) lastly the sale of commodities of commerce. Even conquest, tribute or plunder, cheating and gambling not unlike the craze of modern speculation and gambling (horse-race and lottery) and other *means of "wicked prosperity"* are mentioned as means of acquiring wealth, and it is no wonder that *honesty as trade principle* did not find any prominent place in the Indian economics.

The *trades and professions* prescribed by the ancient Hindus, unlike the Cornellian system which provides education for all men in all studies, were at first only ten and afterwards increased to twelve, namely:—

1. *Profession* of teaching (Professor), of medicine (Physician), of religious instruction (Priesthood and clergy), of book-making (Author), of pleading (Lawyer) and of oratory (Orator).
2. Artists and artisans—Industry and Fine Arts of which there were sixty-four varieties.
3. Farming and cattle raising (farming).
4. Commerce.
5. Usury.

6. Making mats.
7. Making conveyances.
8. Flattery and buffoonery.
9. Service.
10. Agriculture.

Thus the foundation of the modern technical education began from an originally simple and non-scientific system of ancient India and gradually spread westward through Persia, Assyria, Babylon, Asia Minor, Egypt, Greece and Italy, assuming its present scientific state of development through centuries of evolution.

## The Romantic side of Invention, Industry and Science.

The romantic side of invention, industry and science is not without its interest and attraction. "Truth is stranger than fiction and fact is more wonderful than Fancy's wildest dreams." The earth is filled with romance and we are both workers and learners in this fairy land. There is music and poetry in machinery and merchandise. The dreams of the Arabian Nights are to-day fulfilled. The older order changeth and the thoughts of men are widened with the process of the sun. Our very willingness to admit our ignorance and honest doubt is a potent factor in developing wisdom out of the bounds of human knowledge and thought. The mediæval speculative philosophy and the arbitrary authority of cults, traditions and superstitious beliefs have yielded to the modern material science and rational authority evolved by the gradual elimination of pre-historic

errors of intellect purified in the crucible of modern free thought.

Not an inch of ground that has been conquered by the mechanicians and the scientists has ever been reconquered in fair fight by theology or metaphysics. Again and again the old metaphysical creeds have been falsified by tangible observations. The subjective philosophy of the imagination has given place to the objective philosophy of facts, matured in the true school of experience. Deductive science with its hasty generalisation has, like a phantom conjured by speculative imagination, yielded to inductive science and its logical induction. The arch-enemy of scientific progress is the "baleful heritage" of superstitious beliefs or primitive conceptions, metaphysical guesses, the a-priori-methods of the dogmatists and the historico-critical methods of the humanists, which are so often accepted by a majority of men as the final dictates of ancient systems of philosophy and are most difficult to eradicate from our ingrained nature. Thus history repeats itself and tyranny alters its form from one age to another.

With all the combined efforts of fancy and the vast fragments of accumulated truths of ages, the concealed cause or the nature and origin of the Great Unknown shall ever remain behind the veil of mystery and never come within the limited range of man's mundane speculations; man's greatest glory is not what he cannot know, but what he can know by the ever-pinching stimulus of the how, the wh n and the why. His concern is to co-operate with nature, and stops with the utility or results of things and the welfare and economy of man and no further. Philosophy, religion and science all alike are dumb in amazement, and

like a Socrates or a Newton shall ever proclaim the patent vastness of human ignorance. It is idle to boast of authority or tradition, revelation or intuition, analogy, theory or guesses and all our tentative ideas or devices of the fallible human mind to make up for the missing link of the Great Unknown or the origin of the so-called Cosmic Laws. Man's intellectual wealth in philosophy, science, art and literature is on a constant increase with the endless variety of means and modes of his enjoyment and culture, but it cannot enslave his capacity for further original thinking or dull his appetite for knowledge. Indeed the empirical, the imaginative, and even guess work system or lack of system each has its days before the advent of scientific research. The science of the laboratory to-day rules the field, the factory, the workshop and the kitchen on which we depend for our very existence. *Electricity* has given us the wonderful lamp of Alladin. The twitchings of a dead frog's legs foretold the telegraphic message. Chemistry has robbed the cavern treasure of Ali Baba. It has increased the fertility of the soil and has provided the modern navies and the armies—which are the law-sustainers and peace-makers of the land, with new weapons such as the Gatling-guns" magazine rifles, dynamite shells, the "dreadnoughts" and the "greyhounds" of the sea. The enlightened spiritual brain of the West has endowed us with *more eyes* than those of a Ravana—namely :—the telescope, the microscope, the ultra-microscope, the spectroscope, the camera and the fluoroscope. Even the dumb cold iron is made to speak by means of the *Telephone* and the "*Telephone Newspaper*" as fast as the thirsting ear can drink the sound. In the present day orchestra of civilization even dead inanimate

matter such as wax or vulcanite is made to hold sweet converse with the Lords of the Creation by means of the *Phonograph* and the *Gramophone*. Science or the philosophy of facts does not annihilate industry but creates, cheapens and multiplies labour and human activities, and bestows enlarged capacities for happiness to mankind by promoting the material, moral, social and intellectual advancement. If it destroys the old, it creates new ones in its stead. If it is a means of enervating luxury and effeminacy, it is none the less used for the advancement of knowledge, goodness and benevolence, setting free the faculty of freedom as a means to the goal of humanity. The intellectual triumphs and the moral influences of science are not less marked than her material benefits or gifts by removing hardship and suffering, and diffusing ease and comfort to the rich and the poor alike. For according to Macaulay, science is a philosophy which never rests. Its law is progress. The cold spirit of open-eyed science has not chilled the creative impulse of imagination or the spirit of heroism. There is no less heroism in the deeds of *modern philanthrophy* of a George Peabody or a Carnagie, or the bequests for scientific researches by a Smithson, Hodgson, Nobel or a Tata. The *martyrs of science* depressed by poverty and the physicians or trained nurses regardless of their lives in the midst of contagion are not a whit wanting in bravery fortitude and self-immolation for a cause that is dearer than their lives. Such sacrifices and heroism of the votaries of peace are not less contagious than the deeds of a warrior. The memory of a Florence Nightingale—the "ministering angel" and the mother of the nursing profession—shall ever be

cherished in the hearts of the physicians and the suffering humanity. Hargreaves and Crompton—the inventors of the spinning jenny and spinning mule,—Lee, the inventor of the stocking loom,—Howe, the inventor of the sewing machine,—Goodyear, the inventor of vulcanized rubber,—Palissy, the inventor of enamel pottery,—are a few names of the martyrs of invention and industry who sacrificed themselves in laying out the foundations of the world's modern manufactures.

To-day we have all sorts of *material lights*—the candle, the kerosine, the gas burner, the acetyline gas, the Welsbach mantle and the electric arc light—evolved out of man's inward moral lights,—all *sorts of conveyances* side by side—the horsed vehicle, the railway locomotive, the steamship, the bicycle, and the motor-bus,—all *sorts of writing instruments* namely :—the steel pen, the stylo pen, the fountain pen, the type-writer and the pencil—none interfering with each other's field of action.

All matter, whether solid, liquid, gas or radiant, is obedient to man. He has conquered the so-called five elements—the fire, the earth, the water, the air and the limitless space pervading medium of æther. He can roam at ease in land, ocean and air by means of the rail, the steam-boat and the æroplane or the dirigible balloon. He has harnessed æther for the transmission of power and message. Since Franklin first seized the clouds to rob their thunder by his kites, he has now learnt to tap the electricity present in the air by means of the new element of radium. Thanks to the indefatigable energy and indomitable perseverance of Messrs. Peary, Cook and Shackleton, he has set his triumphant foot on *the*

*North and the South Poles* after many an unsuccessful "dash for the poles" through the past four centuries by Hudson, Franklin, Nansen and Andree.* He has stolen the fires of Prometheus and developed the dismally ancient mechanical fires of the flint and the steel into the ultra-modern chemical fires of the *safety match.* He has *harnessed darkness* even to light his lamp at night. He has yoked the spiritual ocean of air, and like a conjuror burns it to make his daily food and meat. The Atmospheric Products Company at the Falls of Niagara or at Norway to-day manufacture from inert and invisible air the calcium carbide for the production of acetyline gas, the phosphorus, the nitric acid and the nitrogenous manures or fertilizers. Thanks to the French Chemist Moissan, the *electric furnace* has placed man face to face with the sun, attaining an enormous heat of 6000° F. Even the old sun is put to new work at his bidding by means of the sun-beam mirror-motor at California. The invisible air itself is to-day robbed of its breezy life—liquefied and even frozen dead like a door nail by the chemist, who can now reach the chilly goal of *absolute zero* at —460° F. at the icy North Pole of his laboratory. The fire which is generated from the element of water by means of the dynamo to-day cooks his meat and bread made from the air. The *hypodermic needle* and the chloroform, chloral and cocaine have robbed him of the terrors of pain. The snake venom he fears not. The *vaccine and the serum therapy*, thanks to the higher and real Homœopathy of Jenner, Pasteur, Koch, Roux, Metchnikoff, Haffkine, Behring and Calmette, have given him fresh immunities from diseases. *Hygiene and Sanitary Science* have given a

new lease of life to mankind by lengthening the brief span of his mortal existence. During the Epic Ages of the Ramayana and the Mahabharata the Hindus were proverbial for their longevity by their observance of the laws of Hygiene and Sanitary Science forming part and parcel of their religion and by their sticking scrupulously to clean air, clean water, clean milk and clean food, but now in India Hygiene and Sanitary measures are little understood and even opposed by the people. In Europe the slums have been banished from Germany and Sweden, but in India the vast masses live in extreme wretchedness from time immemorial. Vaccination has been introduced in opposition to the wishes of the people and to-day nearly eight millions of children are annually vaccinated. It is by an irony of fate that the average length of an Indian life is to-day twenty-three for man and twenty-four for woman, whereas it is fifty for man, and fifty-three for woman in the European countries. The total death-rate in India is similarly highest, being forty-two per thousand and nearly double the British death-rate. In malaria alone there is more than one million deaths per annum. Government distributes millions of packets of quinine through the Post Office at less than cost price. The *Atlantic Cable* and the *Electric Telegraph* and the *Marconigraph* have annihilated time and space through land and ocean. The telegraph and marconigraph have successfully "shadowed" the criminal in the darkest land and misty ocean, and nowhere is he safe now from the invisible earth-embracing arms of the Law. Like the Ariel of Fiction he can roam invisible in the celestial vault beyond the boundaries of fact and fiction. With the *telescope*, the *spectro-*

*scope* and the *camera* he can hold communion with the limitless space of other worlds, witnessing their births and deaths by means of the constant wireless messages sent by the sun and the stars through the medium of the æther waves, and determining the constituents of the heavenly bodies. With the *microscope* and the *ultra-microscope* he can see the wonders of the invisible world in every germ, atom and diatom, and the mystery of the beginning of life in cells, germs and parasites. The microscope reveals the fraud in an instant to the dealers in cotton and woollen fabrics. In pharmacy it detects the adulteration of drugs. In handwriting it points to the forgeries at a glance. In Bacteriology as well as in commerce its uses are legion. With an invisible hand he can draw by means of the camera obscura with the softest touch of light. *Astronomy* gives us the idea of the immensity of space through the history of the solar system. *Geology* takes us back over hundred millions of years through the pages of the earth's past history and shows us vividly the almost inconceivable duration of the habitable phase of our globe. By observing the snowfall in the Himalayan Mountains due to the variations in temperature of the numerous sun-spots and the periodical winds and cyclone-hunting by means of the Barometer, the Thermometer, the Hygrometer, the wind-vane and the telegraph, weather forecasts and average rainfall are predicted with success at least in one place on the globe—*viz.*, the Middle Ganges Valley of Northern India. The greatest triumph of *Practical Meteorology* was the prediction of the drought of 1896 with the consequent famine and plague which visited India the next winter.

The legend of Nautilus has given place to the steam-ship—the modern sea-butterfly. Thanks to Bell, man can speak unseen through space by means of the telephone. The *railway*, the *steam-ship*, the *bicycle* and the *motor-buss* take him to any distance on land and ocean as quickly as thought. With the cheap *facilities of transport* men have learnt to travel by rail. The travel facilities have formed a potent factor in breaking down the mental and moral isolation and bigotry of centuries even in the "unchanging East." Thanks to Morse the lightning is his swift secretary, swifter than light or sound, the horse or the rail. He can dive or sail under the sea by means of the *diving bell* or the *submarine torpedo boat*.

The *romance of mining industry* tells us of the paradise not in the heavens but in the bowels of the earth —in its bottled sunshine and concealed gems. He has tapped the hidden supplies of Nature—its water, oil and gas stored up in the bowels of the earth, by means of the *artesian wells*. The *spectroscope* is the blind man's eye, for with his "dark" intellectual eyes to-day he actually sees the ghosts of the "dark stars" of the sky, peeping behind the veil of the invisible stars. *The Engineering science* has given to man the many wonders of to-day by bridging great rivers with iron suspension bridges and subterranean tunnels, connecting oceans by large canals for the passage of ships, and piercing mountains by ingenious tunnels for the iron-horse. "He has built beacons and breakwaters for the mariner, reared lofty architectures of masonry and steel, drained marshes, irrigated deserts and reclaimed lands from the womb of the sea." The modern Eiffel tower of

iron in Paris one thousand feet in height, the Washington Monument five hundred and fifty-five feet high and the Iron Sky-scrappers of America are not less wonderful than the Pyramids of Egypt and the Cleopatra's Needle, the famous solid iron pillar of Delhi sixteen inches in diameter and thirty feet high, erected in the reign of Chandra Gupta II, or a Kutab Minar—forming a few fragments of the glorious past.

Just as the manifestation of gaseous matter may even elude our common senses of hearing, smell, sight, taste and touch, so solid matter—apparently dead or motionless as a door-nail—imperceptibly changes its form and functions incessantly through slow action of wind, frost and shower, moving glacier and oscillatory changes of the continental masses, like the unstable and slowly disintegrating element of radium, and passing through the flowing liquid into the invisible and omnipresent gaseous state. We see in it the manifestation of slow and ceaseless changes and evolution or development of matter, the action and reaction of its greater and lesser forms, the force of gravity or energy of matter varying according to quantity or mass, life begetting life, matter begetting matter, the one in many and the many in one, the limited world unity or conservation of force, matter and mind, and the imperceptible universal evolution of the planets, of the elements, of the plants, of the animals or of the not-living to the living matter. We see in it the ceaseless division and multiplication, evolution and decay everywhere in the universe. The mutability or the law of so-called spirit or energy is inherent in universal matter which knows no birth or death, by which the lesser realm of matter by qualitative and quantitative changes in its mass is

transmitted into the conscious spiritual realm of mind—the united larger matter or aggregation of nerve electrons. Ever united in partnership by the progressive habit of matter, energy and æther we stand self-conscious to work wonders in our corporal body but disunited we fall.

Just as there is no line of demarcation between a vegetable and an animal protoplasmic unit of matter, for responsivity, consciousness or memory is an universal function of organised matter, so there is no plumb line to ascertain the depth of difference between an organic protoplasmic cell or egg and an inorganic atom or electron of matter. In short the triumvirate of the mineral, the vegetable and the organic matter governs the materio-spiritual world of our planet. Thus matter ends in all-pervading mind, and mind or nerve-matter begins afresh in matter, the physics and psychics,—matter and mind each symbolizing the other. The cycle of the world's non-self-sustained systems of life—sexual or asexual, organic or inorganic—goes on for ever by unending evolutions from simple to complex and back again from complex to simple. The alleged "missing link" between the living and the not-living matter is a myth of the preconceived mind, for in the broader view of facts there can be no gap in the life-bearing stage of the cosmic evolution of our planet—no break or breeches in the incessant reciprocity of the actions of the electrons or atoms of matter whether in outside space or in the brain of man.

All nature responds to man's ever-restless touch of scepticism. All knowledge reveals to him at his beckoning. The universe of the three entities—matter, æther and energy—plays with him by trans-

formation or transmission of its twelve forms of sportive G's. Now he is a grand disillusioned protean player in the world's stage. Again he witnesses its cosmopolitan play as an optimist when in health or as a pessimist when in a diseased condition. His restless unconquerable material spirit or mind, thinking or working, his wants and aspirations, like wonder-working radium give him mastery over living or not-living matter—solid, liquid, gas or radiant,—and at his sweet will he can transform or transmute himself into any of those fleeting states or little systems of which he forms a very small part.

About the Gospel of Industrial Life let us now say, with the words of the poet, that *self-reverence*, *self-knowledge* and *self-control*—these three alone lead life to sovereign power unknown to the Cæsars, yet not for power, that of itself would come uncalled for, but to live by rule, and acting the rule, we live by without fear with a larger hope lapt in universal law, and wisely follow right not from hope of reward, but because right is right

# Opinions of Government Officials

who have visited

## THE LUXMI STYLO-PEN WORKS,

## BENARES.

**The first and only engine-turned Stylo and Fountain Pen Factory in India.**

*Established* 1907.

1. E. H. Radice, Esq., C.I.E., Collector and Magistrate, Benares, writes:—I visited to-day the Luxmi Stylo-Pen Works this morning. I had no idea anything so good and complete in a small way existed in Benares. All the work from the rough materials is made on the spot, and even one of the lathes and the majority of the tools have been made here. I wish Dr. R. N. Saha's enterprise every success.
2. C. A. C. Streatfeild, Esq., I.C.S., Collector, Benares, writes:—I visited the manufactory of Dr. R. N. Saha's Patent "Swadeshi" Stylographic Pen. The work is managed by Dr. R. N. Saha who has shown much enterprise and ingenuity in putting up the factory and working it. The pens write very well indeed.
3. W. Gaskell, Esq., I.C.S., Collector, Benares, writes:—I visited the Luxmy Stylo-Pen Works of Dr. R. N. Saha, Benares. I was extremely interested in the work which I saw, and in the Fountain Pen and Calendar Pen inventions of Dr. Saha.
4. A. P. Collett, Esq., I.C.S., Joint Magistrate, Benares, writes:—I have been most interested in seeing Dr. R. N. Saha's Luxmy Stylo Pen Factory. The ingenuity of the inventions and the manner in which all the parts and even the machinery are made locally mark out the proprietor as a pioneer of Indian scientific enterprise.
5. G. O. Allen, Esq., I.C.S., Assistant Magistrate, Benares, writes:—I have been most interested to see Dr. R. N. Saha's Fountain Pen Factory, and consider it an exceedingly praiseworthy undertaking which does him great credit.

I can testify to the excellence of the pens as I am now using one.

6. W. J. O. Geady Gee, Esq., A.M.I.C.E., Benares, writes :—Dr. R. N. Saha has shewn me over his "Luxmy Stylo-Pen Works" where I saw his patent wireless stylo and patent tubular feed Fountain pens being turned out. The whole process was most interesting, and I wish Dr. Saha every success in his undertaking.

7. Mr. A. L. Kaye and Mrs. A. L. Kaye with Mr. C. U. Peters of the U. P. Police, Benares, write :—We have been round Dr. R. N. Saha's Stylo-Pen Works and found them very interesting.

8. W. E. Wood, Esq., Superintending Engineer, U. P., writes :—I visited the Luxmi Stylo Pen Works and was kindly shown over the workshop by Dr. R. N. Saha. He seems to turn out work quickly and neatly, and evidently takes a great deal of interest in it.

9. G. J. M. Hamilton, Esq., Agent, Bank of Upper India, Ld., Allahabad, writes :—I have inspected the Luxmy Stylo-Pen Factory of Dr. Saha. It is most interesting and deserves every encouragement. These are the lines in which India should work out its own salvation on the industrial plane.

## OTHER UNSOLICITED TESTIMONIALS.

10. P. Bruhl, Esq., Assistant Secretary to Government of India and Professor C. E. College, Sibpur, writes :—Dr. Saha's patent Stylo-pen is simpler than those in the market, is based upon sound scientific principles, is simple in construction and certain in action.

11. R. W. F. Shaw, Esq., M.A., Principal Hooghly College. writes :—Dr. Saha's Stylo-pen is very satisfactory and free from the defects which characterize the pens of the market.

12. B. Heaton, Esq., Principal C. E. College, Shibpur, writes :—Dr. R. N. Saha's patent Fountain-pen is a distinct improvement on the existing types.

13. K. G. Gupta, Esq., Formerly Member Board of Revenue, now Member India Council, London, writes :—Your pen is neat, durable and well made, and the ink flows freely.

14. L. G. Fischer, Esq., I.M.S., Civil Surgeon, Dehra Dun, writes :—After trying Dr. R. N. Saha's stylographic pen I find it writes very well, the ink flowing readily. It is decidedly a cheap pen and good value.

15. P. E. Butcher, Esq., Resident Surgeon of the Government X-Ray Institute, Dehra Dun, writes:—I have used Dr. R. N. Sahâ's pens. They are extremely well made, and in appearance and utility they are equal to the European articles.

## A FEW PRESS OPINIONS.

16. The Indian Daily News, Calcutta, writes:—A new industry and one which deserves every encouragement is the manufacture of Stylo and Fountain Pens made by the Luxmi Stylo-Pen Works Co., of Benares. They are made from Dr. R N. Saha's patent entirely in Bena es. They also manufacture a Stylo and Fountain Calendar Pen and an automatic desk calendar which are marvels of ingenuity.

17. The Statesman, Calcutta, writes:—The Stylo and Fountain pens made at the Luxmi Stylo-Pen Works, Benares, are extremely cheap: they write well, and are durable. They are both patents invented by Dr. R. N. Saha, and the design in each case is of such simplicity that there is nothing to get out of order. In the "Wireless" Stylo-Pen the long air tube in the barrel and the delicate needle inside the writing section, which gives so much trouble in most Stylos, is done away with, while the Fountain pen is made on the tubular feed system and is fitted with 14-carat gold nib. iridium tipped. For such good pens the price is extremely low The pens are manufactured in India by skilled Indian workmen, and are pure "Swadeshi."

18. The Bengalee, Calcutta, writes: Among the recipients of gold medals at the Noakha i Exhibition Dr. R. N. Saha of Benares has been awarded a gold medal for his patent Stylo and Fountain Pens, manufactured at the Luxmi Stylo-Pen Works, Benares.

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